



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

A 757,799

HYDRAULIC AND OTHER TABLES

for purposes of
SEWERAGE & WATER-SUPPLY

By
THOMAS HENNEL

M. INST. C. E.

THIRD EDITION





HYDRAULIC AND OTHER TABLES

1841-1842 1843-1844 1845-1846 1847-1848 1849-1850

HYDRAULIC AND OTHER TABLES

FOR PURPOSES OF

SEWERAGE AND WATER-SUPPLY

BY

THOMAS HENNEL

M. INST. C.E.

THIRD EDITION, REVISED



London:

E. & F. N. SPON, LTD., 57 HAYMARKET

New York:

SPON & CHAMBERLAIN, 123 LIBERTY STREET

1908

20

21

PREFACE TO THIRD EDITION.

WHEN First Edition of the Tables became exhausted, the Author thought it only right, before reprinting, to bring some parts of the work more nearly up to date.

He therefore, in the Second Edition, rewrote Tables X., XI., XII. and XV., relating to Rainfall and Analysis of Water, availing himself for that purpose of more recent observations and researches; and the Introductory Remarks have been altered in accordance.

The subject of Flow in Pipes and Channels has been investigated by numerous authorities, both mathematicians and engineers, during the past twenty-five years, and many series of experiments have been made under varying circumstances.

No formula has, however, yet been arrived at which can be universally accepted as superseding that on which the Tables are based, and the Author does not think any apology necessary for reproducing them as they are.

He has, however, endeavoured in the Introductory Chapter to make some comparison between them and the results obtained by other methods, and so to indicate more fully than he did before the limits within which they should be relied on for practical use.

The Tables on pages 67, 68, 69, relating to Flow

in 6, 7, and 8-inch Sewers, have been added as supplemental matter in the Third Edition.

The Local Government Board at one time objected to public sewers less than 9 inches in diameter. They have, however, for some time ceased to do so, and these smaller sizes are now in frequent use in public works.

With regard, however, to the figures given in the Tables for flows of less than 2 to 3 inches in depth, they should be taken as applicable only to clear water flowing in perfectly smooth channels with even fall. With sewage there must, especially with the flatter gradients, always be liability to deposit, and a nearer approximation will generally be obtained by taking the average depth as somewhat less than it appears where measured.

PARLIAMENT MANSIONS,
VICTORIA STREET, WESTMINSTER,
February 1908.

PREFACE TO FIRST EDITION.

It has been found that the Engineering Pocket Books in most general use give comparatively little information relating to Sewerage and Water Supply. And even the large and valuable works of the late Mr. Beardmore and others contain somewhat abridged Tables applicable to the calculations most frequently required in designing and carrying out works of moderate size.

The Tables in this book have been calculated from time to time by the author to meet his own requirements. Thinking it probable that other engineers will have experienced the same want as himself, he has now been induced to make them public. The greater part have been used in manuscript for some years ; but a few additional Tables have been recently added in order to make the work more complete.

Every precaution has been taken, as far as possible, to guard against errors both in the calculations and printing. If however, notwithstanding, any mistakes should be discovered, the author will be greatly obliged by having them pointed out to him.

November 1883.

CONTENTS.

| | |
|--|-----------|
| Introduction and Description of the Tables | PAGE 7 |
| TABLE | |
| I. Quantity of Water contained in Pipes, Wells, and Circular Tanks, per foot in length or depth .. | 13 |
| II. Quantity of Water contained in Square Cisterns, or Tanks, per foot in depth.. .. . | 13 |
| III. Flow of Water through Sluices | 14 |
| IV. Flow of Water over Weirs | 15 |
| V. Flow in Circular Sewers or Conduits at various depths (6 inches to 6 feet diameter) | 16-29 |
| VI. Flow in Egg-shaped Sewers at various depths .. | 30-41 |
| VII. Flow in Pipes (running full) | 42-47 |
| VIII. Quantity of Sewage due to Population | 48 |
| IX. Quantity and Discharge from Areas due to Rainfall | 50 |
| X. Annual Rainfall in British Isles | 52 |
| XI. Monthly Rainfall in ditto | 55 |
| XII. Daily and Hourly Maximum Rainfall in ditto .. | 57 |
| XIII. Water Supply by Gravitation—Works for given Populations | 58 |
| XIV. Water Supply by Pumping—Works for given Populations | 60 |
| XV. Analysis of quality of Water used for Domestic Supplies | 62 |
| XVI. Quantity of Brickwork in Circular Sewers, Culverts, and Wells | 64 |
| XVII. Quantity of Brickwork in Egg-shaped Sewers .. | 64 |
| XVIII. Weight of Cast-iron Pipes | 65 |
| XIX. Weight of Lead Pipes | 66 |
| Appendix :— | |
| Flow in Circular Sewers 6, 7 and 8 inches diameter .. | 67-69 |

DESCRIPTION AND REMARKS ON THE USE OF THE TABLES.



TABLES I. and II. show the quantities of water in gallons per foot contained in pipes, wells, tanks, &c., of given dimensions, and require no explanation.

TABLES III. and IV. give the discharge in gallons per minute of water passing through sluices and over weirs under ordinary conditions. Correction is required in case of bell-mouthed or specially formed orifices, and also where there is any considerable velocity of current in approaching the outlets; but the notes at the heads of the Tables, to which attention should be directed, will enable this to be made with sufficient accuracy for most practical purposes.

TABLE V. shows the velocity and discharge under varying conditions of flow in circular sewers and conduits, from 9 inches to 6 feet in diameter.

In designing and carrying out sewerage works, it is important to know not only the maximum carrying

capacity of the sewers, but also the effect produced by the much smaller quantity which will be generally flowing through them. This is essential in order to ascertain whether flushing will be required, and if so, what quantity of water will be needed for the purpose. The Table consequently shows, not only the maximum discharge and velocity of each kind of sewer under the most favourable circumstances, but also the discharge and velocity of the same sewers when full to one-half, one-quarter, and one-eighth only of their heights respectively. If a sewer should at any time run quite full, its discharge will be somewhat less than that indicated in the fourth column, the velocity of current being in that case considerably diminished by friction against the top. With any circular conduit the velocity when full is exactly the same, and the discharge just double that when half-full; the precise figures for a sewer running full may therefore be ascertained, if required, from the third column of Table by doubling the discharge.

A velocity of 150 feet per minute, or $2\frac{1}{2}$ feet per second, is generally considered sufficient to remove all obstacles of the ordinary character found in sewers. The quantity of water required to produce this velocity in each case is given in the last column

of the same Table, and will be found especially useful in designing flushing arrangements.

TABLE VI. gives precisely similar information for egg-shaped sewers, as Table V. for circular sewers.

TABLE VII. gives the discharge of pipes from $\frac{3}{8}$ -inch to 3 feet diameter, when running full at various inclinations or pressures. It should be remembered that the velocity of water passing through a line of pipes of any considerable length depends not on the inclination of any particular section, but on the hydraulic gradient throughout, or ratio of head of water to length of pipe; the "head" being the difference of level between the surface at or above the upper end of the pipe, and that of the cistern or pond into which it delivers, or if it has a free outlet, the lower end of the pipe itself. This velocity, except for slightly increased friction at bends, is entirely independent of the course of the pipes, whether laid at a uniform inclination or otherwise, also whether commencing at or below the upper surface and discharging, if not freely, at or below the lower surface.

The formula which has been used in the calculations for Tables V., VI. and VII. is that

known as Eytelwein's:—Velocity in feet per second = $94.25 \sqrt{S}$, where R is the so-called “hydraulic mean depth,” i.e. the sectional area divided by the surface in contact, and S the slope or inclination expressed fractionally, e.g. $\frac{1}{100}$ or $\frac{1}{250}$.

The constant number 94.25 has, of course, been arrived at as the result of experiments made from time to time in different kinds of pipes and channels with varying inclinations.

It has, however, long been known that this formula gives generally too high results for small pipes, and too low results for larger pipes and channels; and many other and more complicated formulæ have been from time to time devised in order to accord more nearly with more recent actual observations and experiments.

In addition to the alterations of flow due to the size, shape and inclination of channels, there is also considerable variation caused by the nature of the surface in contact with the water, in what degree it is smooth or rough.

The following Table gives some idea of the varying results that would be arrived at by using the coefficients or formulæ of different observers; the figures given being those which they would in each case substitute for the constant 94.25 used in the

Tables. When two figures are given, the difference is due to difference of inclination within moderate limits.

| Diam. of Pipe running full or half-full. | Darcy. | | | Kutter. | Professor Unwin. | | | Tables. |
|--|--------------------------------|---------------------------------|------|---|--------------------------|------------------------------|------|---------|
| | For Clean Iron Pipes. | For Rusted Iron Pipes. | Mean | For Iron Pipes in Fair Condition. | For Clean Iron Pipes. | For In- crusted Pipes. | Mean | |
| 2 in. | 93 | 66 | 79 | 49·5 to 49 | | | | 94·25 |
| 3 „ | 98 | 69 | 83 | 57 „ 55 | | | | |
| 6 „ | 105 | 74 | 89 | 71 „ 69 | 108 to 104 | 72 | 89 | |
| 12 „ | 109 | 77 | 93 | 87 „ 85 | 112 „ 109 | 76 | 93 | |
| 18 „ | 110 | 78 | 94 | 96 „ 94 | 116 „ 113 | 78 | 96 | |
| 2 ft. | 111 | 79 | 95 | 103 „ 101 | 120 „ 116 | 81 | 99 | |
| 3 „ | 111·5 | 79 | 95 | 111 „ 109 | 124 „ 120 | 83 | 102 | |
| 4 „ | 112 | 80 | 96 | 118 „ 116 | 128 „ 124 | 85 | 105 | |

It will be seen that, according to all the observations, the Tables will give correct results for pipes of a medium size, and too low results for larger ones ; excepting only in the case of incrustated iron pipes, for which the Tables are too high, even with the largest size.

Kutter's figures are calculated from a very elaborate formula,* containing a coefficient which may be

$$* \text{ Velocity in feet per second } = \frac{\sqrt{R}}{n} \frac{M + 1\cdot811}{M + \sqrt{R}}, \text{ where}$$

$$M = n \left(41\cdot6 + \frac{\cdot00281}{S} \right), \text{ and } n \text{ for ordinary pipes } = \cdot013.$$

In order to ascertain with facility the discharge of pipes from 2 to 48 inches in diameter, at varying inclinations, in accordance with this formula, Messrs. E. B. & G. M. Taylor have drawn and published a set of diagrams to a large scale showing curves from which they can be read off by inspection.

varied for different kinds of material, but the figures in the column above are those considered applicable to ordinary cast or wrought iron pipes, or to sewers or culverts of good brickwork or unglazed stoneware. For coated or enamelled iron pipes, or for glazed stoneware pipes, Kutter would use a multiplier giving somewhat higher figures.

As, however, sewers constructed of glazed pipes have necessarily joints not more than 3 feet apart and somewhat irregular, the Author is of opinion that they should be classed with ordinary rather than with specially smooth or enamelled pipes, and that, so far as Kutter's formula is correct, the figures in the Table should apply generally to sewers also.

The Author has himself experimented on the velocities in long lengths of a glazed pipe sewer 2 feet in diameter, running a third to a quarter full, at various inclinations, and has found that the formula on which the Tables are based, gives fairly accurate results in all cases. But when he had made similar trials in a 5-feet sewer, he found the Tables considerably too low. He has not had the opportunity of testing pipes running full, but as the water flowing in a 2-feet sewer one-third deep has the same hydraulic mean depth as that of a 15-inch sewer running full, he would conclude that in that

case also the Tables would be correct, although for sizes larger than 15 inches somewhat too low. This agrees approximately with Kutter.

With reference to pipes under 2 inches in diameter, both Darcy's and Kutter's coefficients would make the figures given in Table VII. much too high, but a series of experiments on lead pipes by Professor Osborne Reynolds showed them in fact only a little high, whereas another formula, Neville's,* makes them in some cases too low.

For pipes of this kind, whether iron or lead, in straight lines of considerable length, and known to be in perfect condition, the Author—on consideration of all the evidence so far recorded—would be disposed to make a small deduction from the Tables, say about 5 per cent. for one inch, and 10 per cent.

* Neville's formula, which has been largely used, and on which are based the Tables of Flow contained in Hurst's and Molesworth's Pocket-Books, is difficult to compare with others, as it shows the velocity composed of two parts, one proportional to the square roots, and the other to the cube roots, of the hydraulic mean depth and inclination. Thus, velocity in feet per second $= 140 \sqrt{RS} - 11 \sqrt[3]{RS}$. This formula makes the flow in small pipes with considerable fall larger instead of smaller than the Tables—in fact, makes the Tables too low for $\frac{1}{2}$ -inch pipes steeper than 1 in 50, for 1-inch pipes steeper than 1 in 100, 3-inch steeper than 1 in 250, 6-inch steeper than 1 in 500, 12-inch steeper than 1 in 1250, 24-inch steeper than 1 in 3000, and for larger sizes, whatever the inclination, the greatest difference for 36-inch pipes being about 17 per cent. But for flatter gradients the Tables for all the smaller sizes are, according to this formula, too high.

for $\frac{1}{2}$ -inch diameters. But pipes of these dimensions as generally used for house services and similar purposes, are subject to so many irregularities, such as sharp bends, angles, contractions or other obstacles to flow, that a much greater deduction is, in practice, really always necessary. In fact, a better approximation to the actual discharge could generally be arrived at by calculating from a smaller diameter of pipe—say, by taking the mean between the figure in the Table for the required diameter, and that for the next size lower.

For iron pipes exceeding 3 inches diameter, if of the best kind, coated inside, or quite new and perfect, the Author would suggest an addition to the figures contained in Tables, varying generally from 5 per cent. for 6-inch to 15 per cent. for 36-inch diameters.

But for iron pipes not so good in condition, and generally for stoneware pipes or sewers running full or half-full, he would consider the Tables correct for diameters of either 12, 15 or 18 inches, according to circumstances; for smaller sizes than these he would make a small deduction, and for larger sizes an addition of about 5 per cent. for each foot in diameter.

As to flow in pipes and sewers running less than half-full, no general rule can be given applicable to varying depths and forms of section, without first

calculating the hydraulic mean depth; but it may be remarked that the hydraulic mean depth of a circular sewer running a quarter full will be approximately the same as that of one a little more than half the size half full, and that of one running an eighth full approximately the same as one of a little more than a quarter the size half full. But where sewage, not clear water, is the material to be dealt with, it is obvious that the flow in small pipes, or shallow channels, cannot be calculated with accuracy, as deposit on the sides and bottom may reduce the sectional area at any point very considerably.

TABLE VIII. is intended to assist in designing the capacity of sewers, and shows at a glance the quantity of sewage, irrespective of rain and surface water, which should be allowed for given populations. In certain cases (see note at foot of Table), the allowance for rain may also be calculated on the basis of population with the help of the last column of the Table, but under ordinary circumstances this should be taken in proportion to area, as shown by Table IX. next following.

TABLE IX. shows the quantity of water due to rainfall over given areas, and the quantities in gallons

per minute, when running off at different rates of flow. The latter columns of the Table are intended for calculating the capacity of sewers ; and the second and third columns for estimating the quantity of water that can be collected from areas and gathering grounds for irrigation or water supply. The areas dealt with range from 100 square feet (representing the roof of a small building) to one square mile.

TABLES X., XI., XII., are rainfall Tables, for the information contained in which the Author is indebted to Mr. H. Sowerby Wallis, who succeeded the late Professor Symons as the recorder of British Rainfall.

TABLES XIII. and XIV. are intended to facilitate the preparation of preliminary reports and rough estimates for works of water supply, and show the approximate dimensions of reservoirs, filter beds, main pipes, pumping machinery, &c., required for the supply of given populations. It is not of course asserted that the constant numbers assumed in the headings of the columns are universally applicable ; and some few, e.g. 100 feet lift to be pumped, are necessarily arbitrary. But the differences due to

variations in these conditions can be ascertained generally either by inspection or by a short calculation, and results may be thus arrived at with much greater facility than if the Tables were not available.

TABLE XV. gives results of analyses of potable waters. To engineers and others, not constantly or very frequently engaged in investigating the quality of water, the figures presented by an analysis convey little information without some readily available standard of comparison. This it is endeavoured to afford by means of this Table, which contains the results of analyses of well-known waters from nearly every description of source.

For many of these the Author is indebted to Dr. Voelcker; others are from analyses by Messrs. Dibdin, Campbell, Thresh, and other well-known chemists.

TABLES XVI. and XVII. give the quantities of brickwork per yard in sewers, culverts, &c., and require no explanation.

TABLE XVIII. gives the weight per yard of cast-iron pipes adapted to different pressures of water. These weights have been arrived at not by theoretical

calculation, but by a careful comparison of the specifications and recent practice of experienced engineers. They agree, however, nearly with the calculated strengths as given by Mr. Box in his Hydraulic Tables. The weights for various safe heads found in Table 14 of Beardmore's 'Manual of Hydrology,' are certainly insufficient according to recent practice.

TABLE XIX. gives the weights per yard of lead service pipes of five different qualities as described in the note appended to the Table.

TABLE I.—QUANTITY of WATER contained in PIPES, WELLS, and CIRCULAR TANKS, per foot in length or depth.

| Diam. | Contents | Diam. | Contents. | Diam. | Contents. | Diam. | Contents. |
|----------------|----------------|---------|----------------|-------|----------------|-------|----------------|
| inches. | gals. per foot | ft. in. | gals. per foot | feet. | gals. per foot | feet. | gals. per foot |
| $\frac{3}{4}$ | ·005 | 1 9 | 15 0 | 11 | 594 | 90 | 39,758 |
| $\frac{1}{2}$ | ·008 | 2 0 | 19·6 | 12 | 7 7 | 100 | 49,088 |
| $\frac{3}{4}$ | ·019 | 2 3 | 21·8 | 13 | 829 | 110 | 59,396 |
| 1 | ·034 | 2 6 | 30·7 | 14 | 962 | 120 | 70,685 |
| $1\frac{1}{4}$ | ·076 | 2 9 | 37·1 | 15 | 1,104 | 130 | 82,956 |
| 2 | ·135 | 3 0 | 44·2 | 16 | 1,256 | 140 | 96,211 |
| $2\frac{1}{4}$ | ·212 | 3 3 | 51·8 | 17 | 1,418 | 150 | 110,447 |
| 3 | ·305 | 3 6 | 60·2 | 18 | 1,590 | 160 | 125,664 |
| 4 | ·54 | 3 9 | 69·0 | 19 | 1,772 | 170 | 141,862 |
| 5 | ·85 | 4 0 | 78·5 | 20 | 1,963 | 180 | 159,044 |
| 6 | 1·22 | 4 6 | 99·4 | 25 | 3,068 | 190 | 177,206 |
| 7 | 1·66 | 5 0 | 122·7 | 30 | 4,418 | 200 | 196,350 |
| 8 | 2·17 | 5 6 | 148·5 | 35 | 6,013 | 250 | 306,796 |
| 9 | 2·75 | 6 0 | 176·7 | 40 | 7,854 | 300 | 441,788 |
| 10 | 3·39 | 6 6 | 207·4 | 45 | 9,940 | 350 | 601,322 |
| 11 | 4·12 | 7 0 | 240·5 | 50 | 12,272 | 400 | 785,400 |
| 12 | 4·91 | 7 6 | 276·1 | 55 | 14,850 | 500 | 1,227,190 |
| 13 | 5·75 | 8 0 | 314·2 | 60 | 17,671 | 600 | 1,767,150 |
| 14 | 6·67 | 8 6 | 354·7 | 65 | 20,740 | 700 | 2,405,290 |
| 15 | 7·67 | 9 0 | 397·6 | 70 | 24,053 | 800 | 3,141,600 |
| 16 | 8·72 | 9 6 | 443·0 | 75 | 27,611 | 900 | 3,975,750 |
| 18 | 11·04 | 10 0 | 490·9 | 80 | 31,416 | 1000 | 4,908,750 |

TABLE II.—QUANTITY of WATER contained in SQUARE CISTERNS or TANKS, per foot in depth.

| Length of Side. | Contents. | Length of Side. | Contents. | Length of Side. | Contents. | Length of Side. | Contents. |
|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|
| ft. in. | gals. per foot | ft. in. | gals. per foot | feet | gals. per foot | feet | gals. per foot |
| 1 0 | 6·25 | 6 0 | 205 | 25 | 3,906 | 90 | 50,625 |
| 1 6 | 14·06 | 7 0 | 306 | 30 | 5,625 | 100 | 62,500 |
| 2 0 | 25·00 | 8 0 | 400 | 35 | 7,756 | 125 | 156,250 |
| 2 6 | 39·06 | 9 0 | 506 | 40 | 10,000 | 150 | 140,625 |
| 3 0 | 56·25 | 10 0 | 625 | 45 | 12,656 | 200 | 250,000 |
| 3 6 | 77·56 | 11 0 | 756 | 50 | 15,625 | 300 | 562,500 |
| 4 0 | 100·00 | 12 0 | 900 | 60 | 20,500 | 400 | 1,000,000 |
| 4 6 | 126·56 | 15 0 | 1,406 | 70 | 30,625 | 500 | 1,562,500 |
| 5 0 | 156·25 | 20 0 | 2,500 | 80 | 40,000 | 1000 | 6,250,000 |

TABLE III.—FLOW OF WATER through SLUICES and OPENINGS.

NOTE.—The "Head of Water" in the Table must represent the depth from the surface to the centre of the opening; or if the opening be submerged, then the difference of level between the surfaces above and below.

If the opening be bell-mouthed, or be a sluice having curved side walls properly tapering inwards to the narrowest part, the discharge will be greater than that shown by the Table, to the extent of, in case of the best form of opening, about 50 per cent.

| Head of Water. | | Discharge per Square Foot in Area of Opening. | Head of Water. | | Discharge per Square Foot in Area of Opening. | Head of Water. | | Discharge per Square Foot in Area of Opening. | Head of Water. | | Discharge per Square Foot in Area of Opening. | Head of Water. | | Discharge per Square Foot in Area of Opening. |
|----------------|----------------|---|----------------|-----|---|----------------|-----|---|----------------|-----|---|----------------|-----|---|
| ft. | in. | gals. per minute | ft. | in. | gals. per minute | ft. | in. | gals. per minute | ft. | in. | gals. per minute | ft. | in. | gals. per minute |
| | $\frac{1}{2}$ | 382 | 2 | 3 | 2,813 | 8 | 3 | 5,385 | 16 | 6 | 7,616 | | | |
| | 1 | 541 | 2 | 6 | 2,964 | 8 | 6 | 5,466 | 17 | 0 | 7,731 | | | |
| | $1\frac{1}{2}$ | 663 | 2 | 9 | 3,110 | 8 | 9 | 5,546 | 17 | 6 | 7,844 | | | |
| | 2 | 765 | 3 | 0 | 3,248 | 9 | 0 | 5,625 | 18 | 0 | 7,956 | | | |
| | $2\frac{1}{2}$ | 856 | 3 | 3 | 3,379 | 9 | 3 | 5,702 | 18 | 6 | 8,064 | | | |
| | 3 | 937 | 3 | 6 | 3,507 | 9 | 6 | 5,779 | 19 | 0 | 8,173 | | | |
| | $3\frac{1}{2}$ | 1,014 | 3 | 9 | 3,631 | 9 | 9 | 5,854 | 19 | 6 | 8,280 | | | |
| | 4 | 1,082 | 4 | 0 | 3,751 | 10 | 0 | 5,929 | 20 | 0 | 8,385 | | | |
| | | | | | | | | | | | | | | |
| | 5 | 1,210 | 4 | 3 | 3,865 | 10 | 3 | 6,004 | 21 | 0 | 8,590 | | | |
| | 6 | 1,326 | 4 | 6 | 3,977 | 10 | 6 | 6,075 | 22 | 0 | 8,796 | | | |
| | 7 | 1,432 | 4 | 9 | 4,086 | 10 | 9 | 6,148 | 23 | 0 | 8,991 | | | |
| | 8 | 1,530 | 5 | 0 | 4,192 | 11 | 0 | 6,219 | 24 | 0 | 9,184 | | | |
| | 9 | 1,624 | 5 | 3 | 4,295 | 11 | 3 | 6,288 | 25 | 0 | 9,375 | | | |
| | 10 | 1,712 | 5 | 6 | 4,398 | 11 | 6 | 6,358 | 26 | 0 | 9,558 | | | |
| | 11 | 1,794 | 5 | 9 | 4,495 | 11 | 9 | 6,427 | 27 | 0 | 9,744 | | | |
| | $1\ 0$ | 1,875 | 6 | 0 | 4,592 | 12 | 0 | 6,495 | 28 | 0 | 9,920 | | | |
| | | | | | | | | | | | | | | |
| | 1 1 | 1,951 | 6 | 3 | 4,687 | 12 | 6 | 6,628 | 30 | 0 | 10,269 | | | |
| | 1 2 | 2,025 | 6 | 6 | 4,779 | 13 | 0 | 6,759 | 32 | 0 | 10,605 | | | |
| | 1 3 | 2,096 | 6 | 9 | 4,872 | 13 | 6 | 6,888 | 34 | 0 | 10,933 | | | |
| | 1 4 | 2,165 | 7 | 0 | 4,960 | 14 | 0 | 7,015 | 36 | 0 | 11,253 | | | |
| | 1 5 | 2,231 | 7 | 3 | 5,048 | 14 | 6 | 7,139 | 38 | 0 | 11,557 | | | |
| | 1 6 | 2,296 | 7 | 6 | 5,135 | 15 | 0 | 7,262 | 40 | 0 | 11,857 | | | |
| | 1 9 | 2,480 | 7 | 9 | 5,219 | 15 | 6 | 7,382 | 45 | 0 | 12,577 | | | |
| | 2 0 | 2,651 | 8 | 0 | 5,302 | 16 | 0 | 7,502 | 50 | 0 | 13,256 | | | |

TABLE IV.—FLOW OF WATER OVER WEIRS.

NOTE.—The "Depth" must represent difference in level between the sill of the weir and the surface of still water above it. If the water approaches the weir with a current having a perceptible velocity, the discharge will be greater than that shown by the Table to an extent depending on the velocity; a velocity of 2 feet per second will be equivalent generally to about half an inch, and a velocity of 3 feet per second to about three-quarters of an inch additional depth.

| Depth. | Discharge per Inch in Width. | Depth. | Discharge per Inch in Width. | Depth. | Discharge per Inch in Width. | Depth. | Discharge per Inch in Width. |
|----------------|------------------------------------|----------------|------------------------------------|-----------------|------------------------------------|---------|------------------------------------|
| inches | gals. per min. | inches | gals. per min. | inches | gals. per min. | ft. in. | gals. per min. |
| $\frac{1}{8}$ | 334 | $4\frac{1}{8}$ | 22·37 | $10\frac{1}{8}$ | 87·5 | 2 1 | 334 |
| $\frac{1}{4}$ | 467 | $4\frac{1}{4}$ | 23·39 | $10\frac{1}{4}$ | 90·8 | 2 2 | 354 |
| $\frac{3}{8}$ | 618 | $4\frac{3}{8}$ | 24·44 | $10\frac{3}{8}$ | 91·1 | 2 3 | 374 |
| $\frac{1}{2}$ | 944 | $4\frac{1}{2}$ | 25·49 | 11 | 97·4 | 2 4 | 395 |
| $\frac{5}{8}$ | 1·329 | $4\frac{5}{8}$ | 26·56 | $11\frac{1}{8}$ | 100·7 | 2 5 | 417 |
| $\frac{3}{4}$ | 1·734 | $4\frac{3}{4}$ | 27·64 | $11\frac{1}{4}$ | 104·1 | 2 6 | 439 |
| $\frac{7}{8}$ | 2·185 | $4\frac{7}{8}$ | 28·74 | $11\frac{3}{8}$ | 107·5 | 2 7 | 461 |
| 1 | 2·670 | 5 | 29·85 | 12 | 111·0 | 2 8 | 483 |
| $1\frac{1}{8}$ | 3·185 | $5\frac{1}{8}$ | 30·97 | $12\frac{1}{8}$ | 118·0 | 2 9 | 506 |
| $1\frac{1}{4}$ | 3·818 | $5\frac{1}{4}$ | 32·12 | 13 | 125·1 | 2 10 | 529 |
| $1\frac{1}{2}$ | 4·305 | $5\frac{1}{2}$ | 33·26 | $13\frac{1}{2}$ | 132·5 | 2 11 | 553 |
| $1\frac{3}{4}$ | 4·905 | $5\frac{3}{4}$ | 34·44 | 14 | 139·8 | 3 0 | 577 |
| $1\frac{5}{8}$ | 5·531 | $5\frac{5}{8}$ | 35·62 | $14\frac{1}{2}$ | 147·4 | 3 1 | 601 |
| $1\frac{3}{2}$ | 6·167 | $5\frac{3}{2}$ | 36·85 | 15 | 155·1 | 3 2 | 625 |
| $1\frac{7}{8}$ | 6·855 | $5\frac{7}{8}$ | 38·02 | $15\frac{1}{2}$ | 163·0 | 3 3 | 650 |
| 2 | 7·552 | 6 | 39·24 | 16 | 170·9 | 3 4 | 675 |
| $2\frac{1}{8}$ | 8·27 | $6\frac{1}{8}$ | 41·72 | $16\frac{1}{8}$ | 179·0 | 3 5 | 701 |
| $2\frac{1}{4}$ | 9·01 | $6\frac{1}{4}$ | 44·25 | 17 | 187·1 | 3 6 | 727 |
| $2\frac{1}{2}$ | 9·77 | $6\frac{1}{2}$ | 46·82 | $17\frac{1}{2}$ | 195·5 | 3 7 | 753 |
| $2\frac{3}{4}$ | 10·55 | 7 | 49·45 | 18 | 203·9 | 3 8 | 779 |
| $2\frac{5}{8}$ | 11·36 | $7\frac{1}{8}$ | 52·12 | $18\frac{1}{8}$ | 212·3 | 3 9 | 806 |
| $2\frac{1}{2}$ | 12·18 | $7\frac{1}{2}$ | 54·84 | 19 | 221·1 | 3 10 | 833 |
| $2\frac{7}{8}$ | 13·02 | $7\frac{3}{4}$ | 57·61 | $19\frac{1}{2}$ | 229·8 | 3 11 | 860 |
| 3 | 13·87 | 8 | 60·41 | 20 | 238·8 | 4 0 | 888 |
| $3\frac{1}{8}$ | 14·75 | $8\frac{1}{8}$ | 62·54 | $20\frac{1}{8}$ | 247·6 | 4 1 | 915 |
| $3\frac{1}{4}$ | 15·64 | $8\frac{1}{4}$ | 66·17 | 21 | 256·9 | 4 2 | 944 |
| $3\frac{1}{2}$ | 16·55 | $8\frac{1}{2}$ | 69·11 | $21\frac{1}{2}$ | 265·9 | 4 3 | 972 |
| $3\frac{3}{4}$ | 17·48 | 9 | 72·09 | 22 | 275·5 | 4 4 | 1000 |
| $3\frac{5}{8}$ | 18·42 | $9\frac{1}{8}$ | 75·12 | $22\frac{1}{8}$ | 284·8 | 4 6 | 1060 |
| $3\frac{1}{2}$ | 19·39 | $9\frac{1}{2}$ | 78·18 | 23 | 294·4 | 4 8 | 1120 |
| $3\frac{7}{8}$ | 20·37 | $9\frac{3}{4}$ | 81·29 | $23\frac{1}{2}$ | 303·9 | 4 10 | 1180 |
| 4 | 21·36 | 10 | 84·43 | 24 | 313·9 | 5 0 | 1240 |

TABLE V.—VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 9 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|---------|-------------------------------------|---------|----------------------------------|---------|-------------------------------------|---------|--|
| | One-eighth. ($\frac{1}{8}$ Inch.) | | One-quarter. ($\frac{1}{4}$ Inch.) | | One-half. ($\frac{1}{2}$ Inch.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Discharge. | | Discharge. | | Discharge. | | Discharge. | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in 20 | 300 | 58 | 420 | 225 | 550 | 755 | 600 | 1335 | gallons |
| 1 " 30 | 246 | 48 | 344 | 195 | 447 | 615 | 490 | 1245 | " |
| 1 " 40 | 212 | 40 | 296 | 158 | 387 | 530 | 424 | 1085 | " |
| 1 " 50 | 190 | 37 | 266 | 143 | 346 | 475 | 380 | 975 | " |
| 1 " 66 | 166 | 33 | 230 | 122 | 302 | 415 | 330 | 845 | " |
| 1 " 80 | 151 | 30 | 209 | 112 | 275 | 377 | 300 | 768 | 30 |
| 1 " 100 | 134 | 26 | 187 | 100 | 244 | 330 | 267 | 682 | 40 |
| 1 " 132 | 117 | 22 | 164 | 84 | 213 | 293 | 232 | 594 | 60 |
| 1 " 165 | 105 | 20 | 146 | 78 | 190 | 261 | 208 | 532 | 85 |
| 1 " 200 | 95 | 18 | 133 | 71 | 173 | 238 | 190 | 487 | 125 |
| 1 " 264 | 83 | 16 | 115 | 62 | 151 | 207 | 165 | 422 | 200 |
| 1 " 330 | 74 | 14 | 103 | 55 | 134 | 184 | 148 | 378 | " |
| 1 " 440 | 64 | 12 | 89 | 48 | 115 | 158 | 128 | 327 | " |
| 1 " 528 | 58 | 11 | 82 | 44 | 106 | 146 | 116 | 291 | " |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 12 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|------------|-----------------------------|------------|--------------------------|------------|--|------------|---------|------|--|
| | One-eighth. (14 Inch.) | | One-quarter. (3 Inches.) | | One-half. (6 Inches.) | | Seven-eighths. (Maximum Discharge.) | | gallons | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | | | |
| | | | | | | | | | | feet | |
| 1 in 30 | 284 | 98 | 396 | 380 | 520 | 1,275 | 686 | 2680 | .. | | |
| 1 " 40 | 247 | 86 | 342 | 330 | 446 | 1,100 | 480 | 2335 | .. | | |
| 1 " 50 | 220 | 76 | 303 | 292 | 400 | 980 | 438 | 2000 | .. | | |
| 1 " 66 | 192 | 66 | 268 | 260 | 348 | 850 | 380 | 1780 | .. | | |
| 1 " 80 | 173 | 60 | 243 | 235 | 316 | 725 | 348 | 1680 | 33 | | |
| 1 " 100 | 155 | 53 | 220 | 212 | 282 | 680 | 309 | 1410 | 45 | | |
| 1 " 132 | 135 | 46 | 188 | 181 | 246 | 600 | 270 | 1280 | 69 | | |
| 1 " 165 | 121 | 42 | 169 | 162 | 220 | 540 | 241 | 1100 | 96 | | |
| 1 " 200 | 110 | 38 | 151 | 145 | 200 | 490 | 219 | 1000 | 135 | | |
| 1 " 264 | 96 | 33 | 134 | 130 | 174 | 425 | 190 | 885 | 212 | | |
| 1 " 330 | 85 | 29 | 119 | 115 | 155 | 380 | 170 | 780 | 320 | | |
| 1 " 440 | 74 | 25 | 103 | 99 | 135 | 331 | 147 | 670 | .. | | |
| 1 " 528 | 67 | 23 | 94 | 90 | 123 | 300 | 135 | 615 | .. | | |
| 1 " 660 | 60 | 21 | 84 | 81 | 110 | 270 | 120 | 550 | .. | | |

**VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 15 Inches.**

| Inclination. | Depth of Flow In Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 feet per Minute. |
|--------------|---|---------|--|---------|---------------------------------------|---------|--|---------|------------|--|--|
| | One-eighth. ($\frac{1}{8}$ Inch.) | | One-quarter. ($\frac{1}{4}$ Inches.) | | One-half. ($\frac{1}{2}$ Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. Discharge. | | Velocity. Discharge. | | Velocity. Discharge. | | Velocity. | | Discharge. | | |
| | feet. | gallons | feet. | gallons | feet. | gallons | feet. | gallons | | | |
| 1 in 40 | 132 | 150 | 385 | 592 | 500 | 1900 | 547 | 3900 | gallons | | |
| 1 " 50 | 106·6 | 250 | 342 | 526 | 446 | 1700 | 498 | 3480 | " | | |
| 1 " 60 | 80 | 218 | 299 | 460 | 386 | 1470 | 438 | 3030 | " | | |
| 1 " 80 | 66 | 196 | 272 | 418 | 352 | 1340 | 386 | 2750 | " | | |
| 1 " 100 | 52·8 | 176 | 242 | 372 | 316 | 1204 | 346 | 2460 | 50 | | |
| 1 " 132 | 40 | 153 | 211 | 325 | 274 | 1044 | 301 | 2140 | 76 | | |
| 1 " 166 | 32 | 137 | 189 | 291 | 245 | 933 | 268 | 1910 | 106 | | |
| 1 " 200 | 26·4 | 125 | 171 | 263 | 223 | 888 | 244 | 1737 | 146 | | |
| 1 " 264 | 20 | 109 | 149 | 229 | 193 | 735 | 213 | 1516 | 225 | | |
| 1 " 330 | 16 | 97 | 134 | 206 | 174 | 662 | 190 | 1360 | 330 | | |
| 1 " 440 | 12 | 83 | 115 | 177 | 150 | 571 | 166 | 1176 | 567 | | |
| 1 " 538 | 10 | 76 | 105 | 162 | 137 | 520 | 150 | 1068 | " | | |
| 1 " 660 | 8 | 68 | 95 | 146 | 123 | 468 | 134 | 954 | " | | |
| 1 " 880 | 6 | 60 | 82 | 126 | 105 | 400 | 116 | 824 | " | | |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 18 Inches.

| Inclination | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|-------------|---|---------|---------------------------|---------|-----------------------|---------|-------------------------------------|---------|-----------|---------|--|
| | One-eighth. (2½ Inches.) | | One-quarter. (4½ Inches.) | | One-half. (9 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Velocity. | | Velocity. | | Velocity. | | Velocity. | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in 50 | 270 | 210 | 382 | 830 | 488 | 2684 | 536 | 5500 | 536 | 5500 | gallons |
| 1 " 66 | 234 | 182 | 326 | 684 | 426 | 2380 | 466 | 4776 | 466 | 4776 | .. |
| 1 " 80 | 213 | 164 | 290 | 625 | 386 | 2120 | 423 | 4336 | 423 | 4336 | 38 |
| 1 " 100 | 190 | 147 | 265 | 573 | 346 | 1903 | 379 | 3885 | 379 | 3885 | 54 |
| 1 " 132 | 166 | 129 | 230 | 497 | 301 | 1655 | 330 | 3382 | 330 | 3382 | 83 |
| 1 " 165 | 148 | 115 | 208 | 450 | 268 | 1474 | 286 | 3024 | 286 | 3024 | 116 |
| 1 " 200 | 135 | 105 | 191 | 414 | 244 | 1342 | 268 | 2747 | 268 | 2747 | 157 |
| 1 " 264 | 117 | 91 | 163 | 340 | 213 | 1171 | 233 | 2388 | 233 | 2388 | 243 |
| 1 " 330 | 105 | 81 | 145 | 312 | 190 | 1046 | 209 | 2140 | 209 | 2140 | 353 |
| 1 " 440 | 91 | 70 | 126 | 272 | 165 | 907 | 180 | 1845 | 180 | 1845 | 580 |
| 1 " 528 | 82 | 63 | 116 | 260 | 150 | 825 | 165 | 1691 | 165 | 1691 | 807 |
| 1 " 660 | 73 | 57 | 104 | 225 | 135 | 740 | 147 | 1507 | 147 | 1507 | .. |
| 1 " 880 | 65 | 50 | 89 | 192 | 116 | 640 | 127 | 1302 | 127 | 1302 | .. |
| 1 " 1056 | 58 | 45 | 81 | 170 | 106 | 585 | 116 | 1190 | 116 | 1190 | .. |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 1 Foot 9 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|----------------|---|-----------------|---|-----------------|--|-----------------|--|
| | One-eighth. ($2\frac{1}{8}$ Inches.) | | One-quarter. ($5\frac{1}{4}$ Inches.) | | One-half. (10 $\frac{1}{2}$ Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| 1 in 50 | feet 292 | gallons 306 | feet 406 | gallons 1200 | feet 524 | gallons 3980 | feet 592 | gallons 8150 | gallons .. |
| 1 " 66 | 80 | 266 | 354 | 1050 | 456 | 3420 | 508 | 7080 | .. |
| 1 " 80 | 66 | 230 | 322 | 950 | 414 | 3115 | 480 | 6440 | 42 |
| 1 " 100 | 52.8 | 206 | 288 | 849 | 370 | 2775 | 411 | 5754 | 58 |
| 1 " 132 | 40 | 179 | 251 | 740 | 322 | 2415 | 368 | 5013 | 89 |
| 1 " 165 | 32 | 160 | 224 | 661 | 288 | 2160 | 330 | 4480 | 125 |
| 1 " 200 | 26.4 | 146 | 203 | 599 | 262 | 1965 | 291 | 4074 | 167 |
| 1 " 264 | 20 | 127 | 177 | 524 | 228 | 1710 | 253 | 3543 | 257 |
| 1 " 330 | 16 | 113 | 158 | 462 | 204 | 1530 | 236 | 3163 | 375 |
| 1 " 440 | 12 | 98 | 137 | 404 | 176 | 1320 | 196 | 2744 | 600 |
| 1 " 528 | 10 | 89 | 125 | 369 | 161 | 1207 | 179 | 2508 | 830 |
| 1 " 660 | 8 | 80 | 112 | 330 | 144 | 1080 | 160 | 2340 | 1270 |
| 1 " 880 | 6 | 69 | 97 | 286 | 125 | 987 | 138 | 1933 | .. |
| 1 " 1066 | 5 | 63 | 89 | 263 | 114 | 855 | 136 | 1770 | .. |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 3 Feet.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. | | |
|--------------|--------|---|---------|-----------------------------|---------|------------------------|---------|--|---------|-----------|---------|--|------------|---------|
| | | One-eighth. (3 Inches.) | | One-quarter. (6 Inches.) | | One-half. (1 Foot.) | | Seven-eighths. (Maximum Discharge.) | | | | | | |
| | | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | | Discharge. | |
| | | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | feet | gallons |
| 1 | in 66 | 270 | 870 | 378 | 1450 | 492 | 4820 | 538 | 9800 | 588 | 9800 | 45 | gallons | |
| 1 | " 80 | 246 | 838 | 344 | 1324 | 446 | 4370 | 490 | 8890 | 490 | 8890 | 62 | 45 | |
| 1 | " 100 | 220 | 801 | 307 | 1182 | 398 | 3900 | 438 | 8000 | 438 | 8000 | 95 | 62 | |
| 1 | " 132 | 191 | 262 | 284 | 1092 | 348 | 3410 | 381 | 6960 | 381 | 6960 | 133 | 95 | |
| 1 | " 165 | 171 | 234 | 239 | 920 | 311 | 3048 | 340 | 6300 | 340 | 6300 | 177 | 133 | |
| 1 | " 200 | 155 | 212 | 217 | 835 | 282 | 2764 | 309 | 5640 | 309 | 5640 | 274 | 177 | |
| 1 | " 264 | 135 | 185 | 189 | 728 | 246 | 2411 | 269 | 4900 | 269 | 4900 | 397 | 274 | |
| 1 | " 330 | 121 | 166 | 169 | 650 | 220 | 2156 | 241 | 4400 | 241 | 4400 | 630 | 397 | |
| 1 | " 440 | 105 | 145 | 146 | 562 | 190 | 1862 | 208 | 3800 | 208 | 3800 | 850 | 630 | |
| 1 | " 538 | 96 | 131 | 134 | 515 | 174 | 1705 | 190 | 3470 | 190 | 3470 | 1300 | 850 | |
| 1 | " 680 | 85 | 116 | 119 | 458 | 155 | 1519 | 170 | 3100 | 170 | 3100 | .. | 1300 | |
| 1 | " 880 | 74 | 101 | 103 | 396 | 134 | 1313 | 148 | 2700 | 148 | 2700 | .. | .. | |
| 1 | " 1058 | 68 | 93 | 95 | 366 | 123 | 1205 | 134 | 2485 | 134 | 2485 | .. | .. | |
| 1 | " 1320 | 60 | 82 | 84 | 323 | 110 | 1078 | 130 | 2300 | 130 | 2300 | .. | .. | |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 2 Feet 3 Inches.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 100 Feet per Minute. |
|--------------|------|---|---------|---------------------------|---------|-----------------------------|---------|-------------------------------------|---------|-----------|------------|--|
| | | One-eighth. (3½ Inch.) | | One-quarter. (6½ Inches.) | | One-half. (1 Foot 1½ Inch.) | | Seven-eighths. (Maximum Discharge.) | | Velocity. | Discharge. | |
| | | Velocity. | | Velocity. | | Velocity. | | Velocity. | | | | |
| | | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in | 68 | 286 | 500 | 400 | 1950 | 520 | 6420 | 570 | 13,180 | | gallons | |
| 1 " | 80 | 261 | 450 | 364 | 1772 | 473 | 5830 | 590 | 11,900 | | " | |
| 1 " | 100 | 232 | 403 | 326 | 1587 | 423 | 5220 | 464 | 10,738 | | 66 | |
| 1 " | 123 | 203 | 353 | 284 | 1383 | 368 | 4541 | 404 | 9,340 | | 101 | |
| 1 " | 165 | 181 | 314 | 253 | 1232 | 329 | 4060 | 361 | 8,346 | | 141 | |
| 1 " | 200 | 165 | 287 | 230 | 1120 | 298 | 3677 | 328 | 7,583 | | 187 | |
| 1 " | 264 | 143 | 248 | 200 | 974 | 260 | 3205 | 285 | 6,589 | | 249 | |
| 1 " | 330 | 128 | 222 | 179 | 872 | 233 | 2875 | 255 | 5,895 | | 419 | |
| 1 " | 440 | 111 | 193 | 155 | 755 | 201 | 2480 | 231 | 5,109 | | 600 | |
| 1 " | 628 | 102 | 177 | 142 | 691 | 184 | 2270 | 202 | 4,670 | | 880 | |
| 1 " | 860 | 92 | 160 | 126 | 614 | 164 | 2024 | 180 | 4,163 | | 1340 | |
| 1 " | 880 | 78 | 135 | 109 | 531 | 142 | 1752 | 157 | 3,620 | | 2250 | |
| 1 " | 1066 | 71 | 123 | 100 | 487 | 130 | 1604 | 143 | 3,300 | | " | |
| 1 " | 1320 | 64 | 111 | 89 | 433 | 116 | 1431 | 128 | 2,959 | | " | |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 3 Feet 6 Inches.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|------|---|---------|---------------------------|---------|------------------------------|---------|-------------------------------------|---------|-----------|------------|--|
| | | One-eighth. (3½ Inches.) | | One-quarter. (7½ Inches.) | | One-half. (1 Foot 3 Inches.) | | Seven-eighths. (Maximum Discharge.) | | Velocity. | Discharge. | |
| | | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| | | | | | | | | | | | | |
| 1 in | 68 | 302 | 650 | 422 | 2520 | 550 | 8420 | 602 | 17,150 | gallons | 42 | |
| 1 " | 100 | 246 | 529 | 344 | 2067 | 447 | 6843 | 486 | 13,851 | 70 | | |
| 1 " | 132 | 214 | 460 | 299 | 1797 | 389 | 5955 | 426 | 12,141 | 106 | | |
| 1 " | 165 | 191 | 411 | 267 | 1505 | 347 | 5312 | 381 | 10,858 | 148 | | |
| 1 " | 200 | 174 | 374 | 243 | 1460 | 315 | 4823 | 345 | 9,832 | 197 | | |
| 1 " | 264 | 151 | 325 | 211 | 1268 | 275 | 4210 | 301 | 8,578 | 303 | | |
| 1 " | 330 | 135 | 290 | 189 | 1136 | 246 | 3766 | 269 | 7,668 | 430 | | |
| 1 " | 440 | 117 | 251 | 164 | 986 | 213 | 3261 | 233 | 6,640 | 690 | | |
| 1 " | 528 | 107 | 230 | 150 | 901 | 194 | 2970 | 213 | 6,070 | 900 | | |
| 1 " | 660 | 96 | 206 | 134 | 805 | 174 | 2664 | 190 | 5,415 | 1380 | | |
| 1 " | 890 | 82 | 176 | 115 | 691 | 150 | 2296 | 165 | 4,702 | 2270 | | |
| 1 " | 1066 | 75 | 161 | 105 | 631 | 137 | 2097 | 150 | 4,275 | 3500 | | |
| 1 " | 1330 | 68 | 146 | 94 | 565 | 123 | 1883 | 134 | 3,819 | .. | | |
| 1 " | 1760 | 58 | 125 | 82 | 493 | 106 | 1630 | 116 | 3,320 | .. | | |

TABLE V.—VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 9 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | Quantity required to give Velocity of 150 Feet per Minute. | | | | |
|--------------|---|------|--|------|-------------------------------------|------|--|--|------|---------|-----|
| | One-eighth. ($\frac{1}{8}$ Inch.) | | One-quarter. ($\frac{1}{4}$ Inch.) | | One-half. ($\frac{1}{2}$ Inch.) | | | Seven-eighths. (Maximum Discharge.) | | | |
| | Velocity. | | Velocity. | | Velocity. | | | Velocity. | | | |
| | Discharge. | feet | gallons | feet | gallons | feet | | gallons | feet | gallons | |
| 1 in 20 | 264 | 300 | 58 | 420 | 225 | 550 | 755 | 600 | 1335 | 30 | 768 |
| 1 " 30 | 176 | 246 | 48 | 344 | 195 | 447 | 615 | 490 | 1245 | 40 | 682 |
| 1 " 40 | 132 | 212 | 40 | 296 | 158 | 387 | 530 | 424 | 1085 | 60 | 594 |
| 1 " 50 | 106.6 | 190 | 37 | 266 | 143 | 346 | 475 | 380 | 975 | 85 | 532 |
| 1 " 66 | 80 | 166 | 33 | 230 | 122 | 302 | 415 | 330 | 845 | 125 | 487 |
| 1 " 80 | 66 | 151 | 30 | 209 | 112 | 275 | 377 | 300 | 768 | 200 | 422 |
| 1 " 100 | 52.8 | 134 | 26 | 187 | 100 | 244 | 330 | 267 | 682 | .. | 378 |
| 1 " 132 | 40 | 117 | 22 | 164 | 84 | 213 | 293 | 232 | 594 | .. | 327 |
| 1 " 165 | 32 | 105 | 20 | 146 | 78 | 190 | 261 | 208 | 532 | .. | 291 |
| 1 " 200 | 26.4 | 95 | 18 | 133 | 71 | 173 | 238 | 190 | 487 | .. | .. |
| 1 " 264 | 20 | 83 | 16 | 115 | 62 | 151 | 207 | 165 | 422 | .. | .. |
| 1 " 330 | 16 | 74 | 14 | 103 | 55 | 134 | 184 | 148 | 378 | .. | .. |
| 1 " 440 | 12 | 64 | 12 | 89 | 48 | 115 | 158 | 128 | 327 | .. | .. |
| 1 " 528 | 10 | 58 | 11 | 82 | 44 | 106 | 146 | 116 | 291 | .. | .. |

VELOCITY and DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 12 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|---------|-----------------------------|---------|--------------------------|---------|--|---------|-----------|---------|--|
| | One-eighth. (1½ Inch.) | | One-quarter. (3 Inches.) | | One-half. (6 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in 30 | 284 | 98 | 396 | 380 | 520 | 1,275 | 666 | 2680 | .. | gallons | |
| 1 " 40 | 247 | 86 | 342 | 330 | 446 | 1,100 | 490 | 2235 | .. | .. | |
| 1 " 50 | 220 | 76 | 303 | 292 | 400 | 980 | 438 | 2000 | .. | .. | |
| 1 " 66 | 192 | 66 | 268 | 260 | 348 | 850 | 380 | 1780 | .. | .. | |
| 1 " 80 | 173 | 60 | 243 | 235 | 316 | 725 | 346 | 1580 | 33 | gallons | |
| 1 " 100 | 155 | 53 | 220 | 212 | 282 | 690 | 309 | 1410 | 45 | .. | |
| 1 " 132 | 135 | 46 | 188 | 181 | 246 | 600 | 270 | 1230 | 69 | .. | |
| 1 " 165 | 121 | 42 | 169 | 162 | 220 | 540 | 241 | 1100 | 96 | .. | |
| 1 " 200 | 110 | 38 | 151 | 145 | 200 | 490 | 219 | 1000 | 135 | .. | |
| 1 " 264 | 96 | 33 | 134 | 130 | 174 | 425 | 190 | 865 | 212 | .. | |
| 1 " 330 | 85 | 29 | 119 | 115 | 155 | 380 | 170 | 780 | 320 | .. | |
| 1 " 440 | 74 | 25 | 103 | 99 | 135 | 331 | 147 | 670 | .. | .. | |
| 1 " 528 | 67 | 23 | 94 | 90 | 123 | 300 | 135 | 615 | .. | .. | |
| 1 " 660 | 60 | 21 | 84 | 81 | 110 | 270 | 130 | 550 | .. | .. | |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 15 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|---------|--|---------|---------------------------------------|---------|--|---------|--|
| | One-eighth. ($\frac{1}{8}$ Inch.) | | One-quarter. ($\frac{1}{4}$ Inches.) | | One-half. ($\frac{1}{2}$ Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. Discharge. | | Velocity. Discharge. | | Velocity. Discharge. | | Velocity. Discharge. | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in 40 | 278 | 150 | 385 | 592 | 500 | 1900 | 547 | 3900 | gallons |
| 1 " 50 | 250 | 135 | 342 | 526 | 446 | 1700 | 498 | 3480 | " |
| 1 " 68 | 218 | 117 | 299 | 460 | 386 | 1470 | 426 | 3030 | " |
| 1 " 80 | 196 | 105 | 272 | 418 | 352 | 1340 | 386 | 2750 | 35 |
| 1 " 100 | 176 | 94 | 242 | 372 | 316 | 1204 | 346 | 2460 | 50 |
| 1 " 132 | 153 | 82 | 211 | 325 | 274 | 1044 | 301 | 2140 | 76 |
| 1 " 165 | 137 | 73 | 189 | 291 | 245 | 933 | 268 | 1910 | 106 |
| 1 " 200 | 125 | 67 | 171 | 263 | 223 | 888 | 244 | 1737 | 146 |
| 1 " 264 | 109 | 58 | 149 | 229 | 193 | 735 | 213 | 1516 | 225 |
| 1 " 330 | 97 | 52 | 134 | 206 | 174 | 662 | 190 | 1350 | 330 |
| 1 " 440 | 83 | 44 | 115 | 177 | 150 | 571 | 165 | 1175 | 567 |
| 1 " 528 | 76 | 41 | 105 | 162 | 137 | 520 | 150 | 1068 | " |
| 1 " 660 | 68 | 36 | 95 | 146 | 123 | 468 | 134 | 954 | " |
| 1 " 860 | 60 | 32 | 82 | 126 | 105 | 400 | 116 | 824 | " |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 18 Inches.

| Inclination | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|-------------|---|---------|------------------------------|---------|--------------------------|---------|--|---------|-----------|------------|--|
| | One-eighth. (2½ inches.) | | One-quarter. (4½ inches.) | | One-half. (9 inches.) | | Seven-eighths. (Maximum Discharge.) | | Velocity. | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| | | | | | | | | | | | |
| 1 in 50 | 270 | 210 | 382 | 830 | 488 | 2684 | 566 | 5500 | feet | gallons | gallons |
| 1 " 66 | 234 | 182 | 326 | 684 | 426 | 2380 | 466 | 4776 | 388 | 388 | 38 |
| 1 " 80 | 213 | 164 | 290 | 625 | 386 | 2120 | 423 | 4336 | 379 | 379 | 54 |
| 1 " 100 | 190 | 147 | 265 | 573 | 346 | 1903 | 379 | 3885 | 330 | 330 | 83 |
| 1 " 132 | 166 | 129 | 230 | 497 | 301 | 1655 | 330 | 3382 | 295 | 295 | 116 |
| 1 " 165 | 148 | 115 | 208 | 450 | 268 | 1474 | 295 | 3024 | 268 | 268 | 157 |
| 1 " 200 | 135 | 105 | 191 | 414 | 244 | 1342 | 268 | 2747 | 233 | 233 | 243 |
| 1 " 264 | 117 | 91 | 163 | 340 | 213 | 1171 | 233 | 2388 | 209 | 209 | 353 |
| 1 " 330 | 105 | 81 | 145 | 312 | 190 | 1046 | 209 | 2140 | 180 | 180 | 580 |
| 1 " 440 | 91 | 70 | 126 | 272 | 165 | 907 | 180 | 1845 | 165 | 165 | 807 |
| 1 " 528 | 82 | 63 | 116 | 260 | 150 | 825 | 165 | 1691 | 147 | 147 | 1507 |
| 1 " 660 | 73 | 57 | 104 | 225 | 135 | 740 | 147 | 1507 | 127 | 127 | 1303 |
| 1 " 880 | 65 | 50 | 89 | 192 | 116 | 640 | 127 | 1303 | 116 | 116 | 1190 |
| 1 " 1056 | 58 | 45 | 81 | 170 | 106 | 585 | 116 | 1190 | | | |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.

Diameter 1 Foot 9 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. | | |
|--------------|---|---------|------------|---------|------------------------------|---------|----------------------------|---------|--|---------|--|------------|--|
| | One-eighth. (2½ Inches.) | | | | One-quarter. (5½ Inches.) | | One-half. (10½ Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | gallons | |
| 1 in 50 | 292 | 306 | 406 | 1200 | 524 | 3930 | 583 | 8150 | .. | .. | | | |
| 1 " 66 | 254 | 266 | 354 | 1050 | 456 | 3420 | 506 | 7080 | 42 | 89 | | | |
| 1 " 80 | 230 | 241 | 322 | 950 | 414 | 3115 | 460 | 6440 | 58 | 89 | | | |
| 1 " 100 | 206 | 216 | 288 | 849 | 370 | 2775 | 411 | 5754 | 58 | 89 | | | |
| 1 " 132 | 179 | 188 | 251 | 740 | 322 | 2415 | 358 | 5013 | 58 | 89 | | | |
| 1 " 165 | 160 | 168 | 224 | 661 | 288 | 2160 | 320 | 4480 | 125 | 167 | | | |
| 1 " 200 | 146 | 153 | 203 | 599 | 262 | 1965 | 291 | 4074 | 167 | 257 | | | |
| 1 " 264 | 127 | 133 | 177 | 524 | 228 | 1710 | 253 | 3543 | 257 | 375 | | | |
| 1 " 330 | 113 | 119 | 158 | 462 | 204 | 1530 | 226 | 3162 | 375 | 600 | | | |
| 1 " 440 | 98 | 103 | 137 | 404 | 176 | 1320 | 196 | 2744 | 600 | 830 | | | |
| 1 " 528 | 89 | 94 | 125 | 369 | 161 | 1207 | 179 | 2506 | 830 | 1270 | | | |
| 1 " 660 | 80 | 84 | 112 | 330 | 144 | 1080 | 160 | 2240 | 1270 | .. | | | |
| 1 " 880 | 69 | 72 | 97 | 286 | 125 | 937 | 138 | 1932 | .. | .. | | | |
| 1 " 1056 | 63 | 66 | 89 | 263 | 114 | 855 | 136 | 1770 | .. | .. | | | |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 2 Feet.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|--------|---|---------|-----------------------------|---------|------------------------|---------|--|---------|-----------|------------|--|
| | | One-eighth. (3 Inches.) | | One-quarter. (6 Inches.) | | One-half. (1 Foot.) | | Seven-eighths. (Maximum Discharge.) | | Velocity. | Discharge. | |
| | | Velocity. | | Discharge. | | Velocity. | | Discharge. | | | | |
| | | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 | in 68 | 270 | 370 | 378 | 1450 | 492 | 4820 | 538 | 9800 | 538 | 9800 | 45 |
| 1 | " 80 | 246 | 338 | 344 | 1324 | 446 | 4370 | 480 | 8830 | 480 | 8830 | 62 |
| 1 | " 100 | 220 | 301 | 307 | 1182 | 398 | 3900 | 438 | 8000 | 438 | 8000 | 95 |
| 1 | " 132 | 191 | 262 | 284 | 1092 | 348 | 3410 | 381 | 6960 | 381 | 6960 | 133 |
| 1 | " 165 | 171 | 234 | 239 | 920 | 311 | 3048 | 340 | 6300 | 340 | 6300 | 177 |
| 1 | " 200 | 155 | 212 | 217 | 835 | 282 | 2764 | 309 | 5640 | 309 | 5640 | 274 |
| 1 | " 264 | 135 | 185 | 189 | 728 | 246 | 2411 | 269 | 4900 | 269 | 4900 | 397 |
| 1 | " 330 | 121 | 166 | 169 | 650 | 220 | 2156 | 241 | 4400 | 241 | 4400 | 630 |
| 1 | " 440 | 105 | 145 | 146 | 562 | 190 | 1862 | 208 | 3800 | 208 | 3800 | 850 |
| 1 | " 538 | 96 | 131 | 134 | 515 | 174 | 1705 | 190 | 3470 | 190 | 3470 | 850 |
| 1 | " 690 | 85 | 116 | 119 | 458 | 155 | 1519 | 170 | 3100 | 170 | 3100 | 1300 |
| 1 | " 880 | 74 | 101 | 103 | 396 | 134 | 1313 | 148 | 2700 | 148 | 2700 | .. |
| 1 | " 1066 | 68 | 93 | 95 | 366 | 123 | 1205 | 134 | 2485 | 134 | 2485 | .. |
| 1 | " 1320 | 60 | 82 | 84 | 323 | 110 | 1078 | 120 | 2300 | 120 | 2300 | .. |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 2 Feet 3 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. | | |
|--------------|---|---------|---------------------------|---------|-----------------------------|---------|-------------------------------------|---------|-----------|---------|--|------------|---------|
| | One-eighth. (3½ Inch.) | | One-quarter. (6½ Inches.) | | One-half. (1 Foot 1¼ Inch.) | | Seven-eighths. (Maximum Discharge.) | | | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | feet | gallons |
| 1 in 66 | 286 | 500 | 400 | 1950 | 520 | 6420 | 570 | 13,180 | 570 | 13,180 | .. | 48 | |
| 1 " 80 | 261 | 450 | 364 | 1772 | 473 | 5830 | 520 | 11,900 | 520 | 11,900 | 66 | 66 | |
| 1 " 100 | 232 | 403 | 326 | 1587 | 423 | 5220 | 464 | 10,728 | 464 | 10,728 | 101 | 101 | |
| 1 " 132 | 203 | 353 | 284 | 1383 | 368 | 4541 | 404 | 9,340 | 404 | 9,340 | 141 | 141 | |
| 1 " 165 | 181 | 314 | 253 | 1232 | 329 | 4060 | 361 | 8,346 | 361 | 8,346 | 187 | 187 | |
| 1 " 200 | 165 | 287 | 230 | 1120 | 298 | 3677 | 328 | 7,583 | 328 | 7,583 | 289 | 289 | |
| 1 " 264 | 143 | 248 | 200 | 974 | 260 | 3205 | 285 | 6,589 | 285 | 6,589 | 419 | 419 | |
| 1 " 330 | 128 | 222 | 179 | 872 | 233 | 2875 | 255 | 5,895 | 255 | 5,895 | 660 | 660 | |
| 1 " 440 | 111 | 193 | 155 | 755 | 201 | 2480 | 221 | 5,109 | 221 | 5,109 | 880 | 880 | |
| 1 " 538 | 102 | 177 | 142 | 691 | 184 | 2270 | 202 | 4,670 | 202 | 4,670 | 1340 | 1340 | |
| 1 " 680 | 92 | 160 | 126 | 614 | 164 | 2024 | 180 | 4,162 | 180 | 4,162 | 2250 | 2250 | |
| 1 " 880 | 78 | 135 | 109 | 531 | 142 | 1752 | 157 | 3,620 | 157 | 3,620 | .. | .. | |
| 1 " 1056 | 71 | 123 | 100 | 487 | 130 | 1604 | 143 | 3,300 | 143 | 3,300 | .. | .. | |
| 1 " 1320 | 64 | 111 | 89 | 433 | 116 | 1431 | 128 | 2,959 | 128 | 2,959 | .. | .. | |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 3 Feet 6 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|---------|------------------------------|---------|---------------------------------|---------|--|---------|-----------|---------|--|
| | One-eighth. (3½ Inches.) | | One-quarter. (7½ Inches.) | | One-half. (1 Foot 3 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in 66 | 80 | 302 | 650 | 422 | 2520 | 550 | 8420 | 602 | 17,150 | 42 | |
| 1 " 100 | 52.8 | 246 | 529 | 344 | 2067 | 447 | 6843 | 486 | 13,851 | 70 | |
| 1 " 132 | 40 | 214 | 460 | 299 | 1797 | 389 | 5955 | 428 | 12,141 | 106 | |
| 1 " 165 | 32 | 191 | 411 | 267 | 1505 | 347 | 5312 | 381 | 10,868 | 148 | |
| 1 " 200 | 26.4 | 174 | 374 | 243 | 1460 | 315 | 4923 | 345 | 9,832 | 197 | |
| 1 " 264 | 20 | 151 | 325 | 211 | 1268 | 275 | 4210 | 301 | 8,578 | 303 | |
| 1 " 330 | 16 | 135 | 290 | 189 | 1136 | 246 | 3766 | 269 | 7,686 | 430 | |
| 1 " 440 | 12 | 117 | 251 | 164 | 986 | 213 | 3261 | 233 | 6,840 | 690 | |
| 1 " 598 | 10 | 107 | 230 | 150 | 901 | 194 | 2970 | 213 | 6,070 | 900 | |
| 1 " 680 | 8 | 96 | 206 | 134 | 805 | 174 | 2664 | 190 | 5,415 | 1380 | |
| 1 " 880 | 6 | 82 | 176 | 115 | 691 | 150 | 2296 | 165 | 4,702 | 2270 | |
| 1 " 1086 | 5 | 75 | 161 | 105 | 631 | 137 | 2097 | 150 | 4,275 | 3500 | |
| 1 " 1380 | 4 | 68 | 146 | 94 | 565 | 123 | 1883 | 134 | 3,819 | .. | |
| 1 " 1760 | 3 | 58 | 125 | 82 | 493 | 106 | 1630 | 116 | 3,320 | .. | |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.

Diameter 2 Feet 9 Inches.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|---------------|------|---|------------|--------------------------------|------------|----------------------------------|------------|--|------------|-----------|------------|--|
| | | One-eighth. (4½ Inches.) | | One-quarter. (9½ In. less.) | | One-half. (1 Foot 4½ Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| | | | | | | | | | | | | |
| feet per mile | | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | gallons |
| 1 in | 66 | 316 | 822 | 444 | 3232 | 576 | 10,675 | 633 | 21,800 | 633 | 21,800 | .. |
| 1 " | 100 | 258 | 671 | 360 | 2621 | 469 | 8,690 | 513 | 17,698 | 513 | 17,698 | 74 |
| 1 " | 133 | 224 | 582 | 313 | 2279 | 407 | 7,542 | 447 | 15,420 | 447 | 15,420 | 111 |
| 1 " | 165 | 200 | 520 | 280 | 2038 | 365 | 6,763 | 399 | 13,765 | 399 | 13,765 | 155 |
| 1 " | 200 | 183 | 476 | 255 | 1856 | 331 | 6,133 | 363 | 12,523 | 363 | 12,523 | 207 |
| 1 " | 264 | 158 | 411 | 222 | 1616 | 288 | 5,337 | 316 | 10,902 | 316 | 10,902 | 316 |
| 1 " | 330 | 142 | 369 | 198 | 1441 | 258 | 4,781 | 282 | 9,729 | 282 | 9,729 | 450 |
| 1 " | 440 | 124 | 322 | 172 | 1252 | 223 | 4,132 | 244 | 8,418 | 244 | 8,418 | 713 |
| 1 " | 538 | 112 | 291 | 157 | 1143 | 203 | 3,761 | 223 | 7,693 | 223 | 7,693 | 940 |
| 1 " | 680 | 100 | 260 | 140 | 1019 | 182 | 3,374 | 200 | 6,900 | 200 | 6,900 | 1420 |
| 1 " | 886 | 87 | 226 | 121 | 881 | 158 | 2,928 | 173 | 5,970 | 173 | 5,970 | 2300 |
| 1 " | 1056 | 79 | 207 | 110 | 801 | 144 | 2,638 | 158 | 5,450 | 158 | 5,450 | 3300 |
| 1 " | 1320 | 71 | 185 | 99 | 753 | 129 | 2,390 | 141 | 4,864 | 141 | 4,864 | .. |
| 1 " | 1760 | 62 | 166 | 86 | 626 | 111 | 2,060 | 132 | 4,210 | 132 | 4,210 | .. |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 3 Feet.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|---------|-----------------------------|---------|--------------------------------|---------|--|---------|---------|--|--|
| | One-eighth. (4½ inches.) | | One-quarter. (9 inches.) | | One-half (1 Foot 6 inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in 66 | 332 | 1027 | 462 | 3999 | 614 | 13,290 | 660 | 27,100 | gallons | | |
| 1 " 80 | 269 | 832 | 376 | 3255 | 489 | 10,760 | 584 | 21,926 | 78 | | |
| 1 " 100 | 235 | 727 | 328 | 2839 | 426 | 9,370 | 464 | 19,053 | 116 | | |
| 1 " 133 | 210 | 650 | 284 | 2458 | 380 | 8,360 | 416 | 17,080 | 162 | | |
| 1 " 165 | 190 | 588 | 266 | 2302 | 346 | 7,610 | 380 | 15,603 | 217 | | |
| 1 " 200 | 166 | 514 | 231 | 1999 | 302 | 6,640 | 330 | 13,550 | 329 | | |
| 1 " 264 | 148 | 458 | 207 | 1792 | 268 | 5,900 | 296 | 12,154 | 468 | | |
| 1 " 330 | 128 | 396 | 179 | 1543 | 230 | 5,060 | 266 | 10,500 | 738 | | |
| 1 " 440 | 117 | 363 | 164 | 1419 | 212 | 4,660 | 232 | 9,526 | 1000 | | |
| 1 " 528 | 104 | 322 | 146 | 1264 | 190 | 4,180 | 208 | 8,540 | 1460 | | |
| 1 " 660 | 91 | 281 | 126 | 1091 | 165 | 3,630 | 181 | 7,432 | 2330 | | |
| 1 " 880 | 83 | 257 | 115 | 995 | 151 | 3,320 | 166 | 6,774 | 3300 | | |
| 1 " 1066 | 74 | 229 | 103 | 891 | 134 | 2,950 | 148 | 6,055 | .. | | |
| 1 " 1320 | 64 | 198 | 89 | 770 | 115 | 2,530 | 128 | 5,255 | .. | | |
| 1 " 1760 | | | | | | | | | | | |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 3 Feet 6 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|------------|------------------------------|---------|---------------------------------|---------|--|---------|---------|-----------|--|
| | One-eighth. (4 Inches.) | | One-quarter. (10 Inches.) | | One-half. (1 Foot 6 Inches.) | | Seven-eighths. (Maximum Discharge.) | | gallons | | |
| | Velocity. | Discharge. | feet | gallons | feet | gallons | feet | gallons | | | |
| | | | | | | | | | | Velocity. | |
| 1 in 66 | 80 | 359 | 501 | 5887 | 651 | 19,530 | 713 | 39,860 | 790 | | |
| 1 " 132 | 40 | 253 | 355 | 4171 | 460 | 13,800 | 504 | 28,200 | 1045 | | |
| 1 " 200 | 26.4 | 206 | 288 | 3384 | 374 | 11,220 | 404 | 23,600 | 1500 | | |
| 1 " 264 | 20 | 179 | 251 | 2949 | 325 | 9,750 | 356 | 19,380 | 2430 | | |
| 1 " 330 | 16 | 160 | 224 | 2632 | 291 | 8,730 | 319 | 17,850 | 3360 | | |
| 1 " 440 | 12 | 139 | 194 | 2279 | 252 | 7,560 | 276 | 15,430 | 5083 | | |
| 1 " 528 | 10 | 126 | 177 | 2080 | 230 | 6,900 | 253 | 14,100 | .. | | |
| 1 " 680 | 8 | 113 | 158 | 1856 | 206 | 6,180 | 225 | 12,590 | .. | | |
| 1 " 880 | 6 | 98 | 136 | 1598 | 178 | 5,340 | 195 | 10,900 | .. | | |
| 1 " 1056 | 5 | 90 | 125 | 1469 | 162 | 4,860 | 178 | 9,960 | .. | | |
| 1 " 1320 | 4 | 80 | 112 | 1316 | 145 | 4,350 | 159 | 8,900 | .. | | |
| 1 " 1760 | 3 | 69 | 97 | 1140 | 126 | 3,780 | 138 | 7,720 | .. | | |
| 1 " 2112 | 2.5 | 63 | 88 | 1040 | 115 | 3,450 | 128 | 7,050 | .. | | |
| 1 " 2640 | 2 | 56 | 79 | 930 | 103 | 3,090 | 113 | 6,320 | .. | | |

VELOCITY AND DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 4 Feet.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|---------|------------------------|---------|---------------------|---------|-------------------------------------|---------|-----------|------------|--|
| | One-eighth. (6 Inches.) | | One-quarter. (1 Foot.) | | One-half. (2 Feet.) | | Seven-eighths. (Maximum Discharge.) | | Velocity. | Discharge. | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in 66 | 80 | 2110 | 536 | 8240 | 695 | 27,240 | 764 | 55,730 | | gallons | |
| 1 " 132 | 40 | 271 | 372 | 5720 | 492 | 19,300 | 539 | 39,340 | | .. | |
| 1 " 200 | 26.4 | 220 | 302 | 4640 | 400 | 15,680 | 438 | 31,970 | | 245 | |
| 1 " 264 | 20 | 192 | 268 | 4120 | 348 | 13,640 | 382 | 27,890 | | 375 | |
| 1 " 330 | 16 | 171 | 238 | 3658 | 310 | 12,150 | 340 | 24,830 | | 535 | |
| 1 " 440 | 12 | 148 | 204 | 3136 | 269 | 10,540 | 294 | 21,460 | | 830 | |
| 1 " 528 | 10 | 134 | 186 | 2860 | 246 | 9,650 | 269 | 19,650 | | 1100 | |
| 1 " 660 | 8 | 121 | 166 | 2550 | 220 | 8,620 | 241 | 17,600 | | 1580 | |
| 1 " 880 | 6 | 105 | 146 | 2244 | 190 | 7,450 | 208 | 15,180 | | 2530 | |
| 1 " 1066 | 5 | 96 | 134 | 2059 | 174 | 6,820 | 191 | 13,940 | | 3500 | |
| 1 " 1320 | 4 | 86 | 119 | 1829 | 155 | 6,075 | 170 | 12,410 | | 5100 | |
| 1 " 1760 | 3 | 74 | 102 | 1568 | 134 | 5,260 | 147 | 10,730 | | .. | |
| 1 " 2112 | 2.5 | 67 | 93 | 1430 | 123 | 4,825 | 135 | 9,830 | | .. | |
| 1 " 2640 | 2 | 60 | 83 | 1275 | 110 | 4,310 | 121 | 8,800 | | .. | |

VELOCITY and DISCHARGE per MINUTE in CIRCULAR SEWERS, with Water flowing at various depths.
Diameter 5 Feet.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. | | |
|--------------|---|---------|------------------------------------|---------|---------------------------------|---------|--|---------|-----------|---------|--|------------|--|
| | One-eighth. (7½ Inches.) | | One-quarter. (1 Foot 3 Inches.) | | One-half. (2 Feet 6 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in 66 | 30 | 428 | 600 | 14,400 | 776 | 47,300 | 862 | 97,180 | 862 | 97,180 | gallons | | |
| 1 " 132 | 40 | 302 | 422 | 10,150 | 548 | 33,400 | 602 | 68,640 | 602 | 68,640 | .. | | |
| 1 " 200 | 26.4 | 246 | 342 | 8,220 | 446 | 27,180 | 488 | 55,680 | 488 | 55,680 | .. | | |
| 1 " 264 | 20 | 214 | 300 | 7,200 | 388 | 23,650 | 426 | 48,590 | 426 | 48,590 | 420 | | |
| 1 " 330 | 16 | 194 | 268 | 6,430 | 348 | 21,210 | 380 | 43,320 | 380 | 43,320 | 590 | | |
| 1 " 440 | 12 | 166 | 230 | 5,530 | 300 | 18,280 | 330 | 37,620 | 330 | 37,620 | 920 | | |
| 1 " 528 | 10 | 151 | 211 | 5,075 | 274 | 16,700 | 301 | 34,320 | 301 | 34,320 | 1,220 | | |
| 1 " 660 | 8 | 136 | 189 | 4,540 | 246 | 15,000 | 268 | 30,550 | 268 | 30,550 | 1,730 | | |
| 1 " 880 | 6 | 117 | 164 | 3,945 | 213 | 12,980 | 232 | 26,450 | 232 | 26,450 | 2,800 | | |
| 1 " 1066 | 5 | 107 | 150 | 3,600 | 194 | 11,820 | 213 | 24,300 | 213 | 24,300 | 3,600 | | |
| 1 " 1320 | 4 | 97 | 134 | 3,215 | 174 | 10,600 | 190 | 21,660 | 190 | 21,660 | 5,380 | | |
| 1 " 1760 | 3 | 83 | 115 | 2,765 | 150 | 9,140 | 165 | 18,860 | 165 | 18,860 | 9,040 | | |
| 1 " 2112 | 2.5 | 75 | 105 | 2,540 | 137 | 8,350 | 151 | 17,160 | 151 | 17,160 | 12,800 | | |
| 1 " 2640 | 2 | 68 | 90 | 2,270 | 123 | 7,500 | 134 | 15,375 | 134 | 15,375 | .. | | |

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 6 Feet.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. | |
|--------------|---|---------|------------------------------------|---------|------------------------|---------|--|---------|--|--------|
| | One-eighth. (9 Inches.) | | One-quarter. (1 Foot 6 Inches.) | | One-half. (3 Feet.) | | Seven-eighths. (Maximum Discharge.) | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | | |
| | feet. | gallons | feet | gallons | feet | gallons | feet | gallons | | |
| 1 in 66 | 80 | 5790 | 652 | 22,580 | 852 | 75,200 | 933 | 153,000 | gallons | |
| 1 " 132 | 40 | 332 | 4110 | 462 | 16,000 | 602 | 53,120 | 680 | 108,400 | .. |
| 1 " 200 | 28.4 | 270 | 3340 | 382 | 13,140 | 488 | 43,060 | 536 | 88,040 | .. |
| 1 " 264 | 20 | 234 | 2895 | 326 | 11,290 | 426 | 37,600 | 466 | 76,500 | .. |
| 1 " 330 | 16 | 210 | 2610 | 290 | 10,040 | 380 | 33,535 | 418 | 68,660 | 640 |
| 1 " 440 | 13 | 182 | 2250 | 252 | 8,720 | 330 | 29,120 | 360 | 59,130 | 980 |
| 1 " 528 | 10 | 166 | 2055 | 232 | 8,000 | 301 | 26,560 | 330 | 54,200 | 1,320 |
| 1 " 660 | 8 | 148 | 1830 | 208 | 7,200 | 270 | 23,830 | 294 | 48,380 | 1,890 |
| 1 " 880 | 6 | 129 | 1600 | 178 | 6,160 | 232 | 20,480 | 254 | 41,740 | 2,950 |
| 1 " 1056 | 5 | 117 | 1448 | 162 | 5,645 | 212 | 18,800 | 233 | 38,350 | 3,850 |
| 1 " 1320 | 4 | 105 | 1300 | 145 | 5,020 | 190 | 16,770 | 209 | 34,380 | 5,670 |
| 1 " 1760 | 3 | 91 | 1126 | 126 | 4,360 | 165 | 14,560 | 180 | 29,660 | 9,340 |
| 1 " 2112 | 2.5 | 83 | 1027 | 116 | 4,000 | 150 | 13,280 | 165 | 27,100 | 13,200 |
| 1 " 2640 | 2 | 74 | 917 | 104 | 3,600 | 135 | 11,915 | 147 | 24,140 | .. |

TABLE VI.—VELOCITY AND DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
Sewer 2 Feet x 1 Foot 4 Inches.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. | | | | | | | | | | | | |
|--------------|------|---|---------|------------|-----------|---------|------------|--------------------------|---------|------------|-----------|---------|------------|--|---------------------|---------|------------|-----------|---------|------------|-------------------------------------|---------|------|---------|--|--|
| | | One-eighth. (3 Inches.) | | | | | | One-quarter. (6 Inches.) | | | | | | | One-half. (1 Foot.) | | | | | | Seven-eighths. (Maximum Discharge.) | | | | | |
| | | Velocity. | | Discharge. | Velocity. | | Discharge. | Velocity. | | Discharge. | Velocity. | | Discharge. | | Velocity. | | Discharge. | Velocity. | | Discharge. | | | | | | |
| | | feet | gallons | | feet | gallons | | feet | gallons | | feet | gallons | | | feet | gallons | | feet | gallons | | feet | gallons | feet | gallons | | |
| 1 in | 50 | 295 | 223 | 380 | 790 | 480 | 480 | 2720 | 595 | 6910 | 6910 | 6910 | 6910 | 6910 | 6910 | 6910 | 6910 | 6910 | gallons | | | | | | | |
| 1 " | 66 | 257 | 196 | 331 | 686 | 417 | 417 | 2360 | 488 | 5440 | 5440 | 5440 | 5440 | 5440 | 5440 | 5440 | 5440 | 5440 | " | | | | | | | |
| 1 " | 100 | 210 | 160 | 268 | 556 | 339 | 339 | 1921 | 381 | 4430 | 4430 | 4430 | 4430 | 4430 | 4430 | 4430 | 4430 | 4430 | " | | | | | | | |
| 1 " | 132 | 183 | 139 | 234 | 486 | 295 | 295 | 1674 | 331 | 3850 | 3850 | 3850 | 3850 | 3850 | 3850 | 3850 | 3850 | 3850 | " | | | | | | | |
| 1 " | 165 | 163 | 124 | 210 | 436 | 264 | 264 | 1496 | 297 | 3450 | 3450 | 3450 | 3450 | 3450 | 3450 | 3450 | 3450 | 3450 | " | | | | | | | |
| 1 " | 200 | 148 | 112 | 190 | 395 | 240 | 240 | 1360 | 270 | 3138 | 3138 | 3138 | 3138 | 3138 | 3138 | 3138 | 3138 | 3138 | 120 | | | | | | | |
| 1 " | 264 | 129 | 98 | 166 | 346 | 208 | 208 | 1180 | 234 | 2720 | 2720 | 2720 | 2720 | 2720 | 2720 | 2720 | 2720 | 2720 | 210 | | | | | | | |
| 1 " | 330 | 116 | 88 | 148 | 305 | 186 | 186 | 1056 | 210 | 2440 | 2440 | 2440 | 2440 | 2440 | 2440 | 2440 | 2440 | 2440 | 330 | | | | | | | |
| 1 " | 440 | 99 | 76 | 128 | 268 | 162 | 162 | 918 | 182 | 2115 | 2115 | 2115 | 2115 | 2115 | 2115 | 2115 | 2115 | 2115 | 620 | | | | | | | |
| 1 " | 528 | 91 | 69 | 117 | 243 | 148 | 148 | 838 | 166 | 1925 | 1925 | 1925 | 1925 | 1925 | 1925 | 1925 | 1925 | 1925 | 920 | | | | | | | |
| 1 " | 660 | 81 | 62 | 105 | 216 | 132 | 132 | 748 | 148 | 1735 | 1735 | 1735 | 1735 | 1735 | 1735 | 1735 | 1735 | 1735 | " | | | | | | | |
| 1 " | 880 | 70 | 53 | 91 | 189 | 114 | 114 | 646 | 120 | 1490 | 1490 | 1490 | 1490 | 1490 | 1490 | 1490 | 1490 | 1490 | " | | | | | | | |
| 1 " | 1058 | 64 | 47 | 83 | 172 | 104 | 104 | 590 | 117 | 1360 | 1360 | 1360 | 1360 | 1360 | 1360 | 1360 | 1360 | 1360 | " | | | | | | | |
| 1 " | 1320 | 58 | 44 | 74 | 153 | 93 | 93 | 527 | 105 | 1230 | 1230 | 1230 | 1230 | 1230 | 1230 | 1230 | 1230 | 1230 | " | | | | | | | |

VELOCITY AND DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
Sewer 2 Feet 3 Inches \times 1 Foot 6 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|----------------|---|-----------------|---|-----------------|--|-----------------|------------|--|--|
| | One-eighth. (3 $\frac{1}{4}$ Inches.) | | One-quarter. (6 $\frac{1}{2}$ Inches.) | | One-half. (1 Foot 1 $\frac{1}{4}$ Inch.) | | Seven-eighths. (Maximum Discharge.) | | Discharge. | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | | | |
| | | | | | | | | | | | |
| 1 in 50 | feet 312 | gallons 300 | feet 402 | gallons 1054 | feet 508 | gallons 4480 | feet 573 | gallons 8400 | gallons | | |
| 1 " 66 | 271 | 260 | 350 | 920 | 443 | 3900 | 497 | 7310 | .. | | |
| 1 " 100 | 221 | 212 | 285 | 747 | 360 | 3175 | 404 | 5940 | 41 | | |
| 1 " 133 | 192 | 185 | 248 | 650 | 314 | 2770 | 352 | 5180 | 63 | | |
| 1 " 165 | 172 | 167 | 222 | 582 | 280 | 2470 | 314 | 4620 | 85 | | |
| 1 " 200 | 156 | 150 | 201 | 527 | 254 | 2240 | 286 | 4200 | 120 | | |
| 1 " 264 | 135 | 130 | 176 | 460 | 222 | 1960 | 248 | 3650 | 210 | | |
| 1 " 330 | 121 | 116 | 156 | 409 | 198 | 1750 | 223 | 3265 | 330 | | |
| 1 " 440 | 105 | 101 | 136 | 356 | 172 | 1512 | 193 | 2824 | 610 | | |
| 1 " 528 | 97 | 93 | 124 | 325 | 156 | 1380 | 176 | 2590 | 900 | | |
| 1 " 660 | 86 | 83 | 111 | 290 | 140 | 1235 | 157 | 2310 | 2000 | | |
| 1 " 880 | 74 | 71 | 96 | 250 | 121 | 1067 | 126 | 2000 | .. | | |
| 1 " 1068 | 68 | 65 | 88 | 210 | 111 | 980 | 124 | 1824 | .. | | |
| 1 " 1320 | 61 | 59 | 78 | 204 | 99 | 874 | 111 | 1633 | .. | | |

VELOCITY AND DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.

Sewer 2 Feet 6 Inches x 1 Foot 8 Inches.

| Inclination. | Depth of Flow in proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|------------|------------------------------|------------|---------------------------------|------------|--|------------|---------|------|--|
| | One-eighth. (3½ inches.) | | One-quarter. (7½ inches.) | | One-half. (1 Foot 3 inches.) | | Seven eighths. (Maximum Discharge.) | | gallons | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | | | |
| | | | | | | | | | | feet | |
| 1 in 66 | 280 | 338 | 371 | 1203 | 467 | 4138 | 523 | 9500 | .. | | |
| 1 " 100 | 226 | 272 | 301 | 972 | 369 | 3350 | 424 | 7700 | 43 | | |
| 1 " 132 | 194 | 238 | 261 | 846 | 330 | 2924 | 369 | 6700 | 65 | | |
| 1 " 165 | 176 | 214 | 236 | 704 | 296 | 2620 | 330 | 6000 | 90 | | |
| 1 " 200 | 160 | 193 | 212 | 687 | 268 | 2375 | 300 | 5450 | 125 | | |
| 1 " 264 | 140 | 169 | 186 | 601 | 233 | 2069 | 261 | 4750 | 210 | | |
| 1 " 330 | 124 | 150 | 165 | 534 | 209 | 1852 | 235 | 4280 | 335 | | |
| 1 " 440 | 108 | 131 | 143 | 463 | 180 | 1598 | 202 | 3670 | 600 | | |
| 1 " 528 | 99 | 120 | 131 | 424 | 165 | 1462 | 185 | 3350 | 890 | | |
| 1 " 660 | 88 | 107 | 118 | 382 | 148 | 1311 | 165 | 3000 | 1500 | | |
| 1 " 880 | 77 | 93 | 101 | 328 | 128 | 1132 | 143 | 2600 | .. | | |
| 1 " 1056 | 5 | 70 | 84 | 92 | 300 | 117 | 1034 | 131 | 2380 | | |
| 1 " 1320 | 4 | 62 | 74 | 82 | 266 | 105 | 926 | 118 | 2140 | | |
| 1 " 1760 | 3 | 54 | 71 | 230 | 90 | 800 | 101 | 1834 | .. | | |

VELOCITY AND DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
 Sewer 2 Feet 9 Inches x 1 Foot 10 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|------------|------------------------------|------------|----------------------------------|------------|--|------------|---------|------|--|
| | One-eighth. (4½ Inches.) | | One-quarter. (9½ Inches.) | | One-half. (1 Foot 4½ Inches.) | | Seven-eighths. (Maximum Discharge.) | | gallons | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | | | |
| | | | | | | | | | | feet | |
| 1 in 66 | 80 | 300 | 387 | 1518 | 489 | 5280 | 550 | 13,050 | .. | | |
| 1 " 100 | 53.8 | 243 | 313 | 1230 | 402 | 4300 | 446 | 9,800 | 45 | | |
| 1 " 132 | 40 | 212 | 274 | 1077 | 345 | 3690 | 389 | 8,550 | 70 | | |
| 1 " 165 | 32 | 190 | 244 | 956 | 308 | 3300 | 348 | 7,720 | 100 | | |
| 1 " 200 | 26.4 | 172 | 222 | 870 | 284 | 3040 | 316 | 6,950 | 130 | | |
| 1 " 264 | 20 | 150 | 194 | 760 | 244 | 2610 | 274 | 6,020 | 215 | | |
| 1 " 330 | 16 | 134 | 192 | 674 | 218 | 2333 | 246 | 5,400 | 345 | | |
| 1 " 440 | 12 | 116 | 168 | 588 | 190 | 2083 | 214 | 4,700 | 588 | | |
| 1 " 528 | 10 | 106 | 153 | 538 | 172 | 1840 | 194 | 4,270 | 880 | | |
| 1 " 660 | 8 | 95 | 137 | 478 | 154 | 1650 | 174 | 3,860 | 1440 | | |
| 1 " 880 | 6 | 82 | 118 | 411 | 133 | 1420 | 150 | 3,300 | 3300 | | |
| 1 " 1056 | 5 | 75 | 108 | 380 | 122 | 1310 | 137 | 3,010 | .. | | |
| 1 " 1320 | 4 | 67 | 96 | 337 | 109 | 1166 | 123 | 2,700 | .. | | |
| 1 " 1760 | 3 | 58 | 84 | 294 | 95 | 1016 | 107 | 2,350 | .. | | |

VELOCITY and DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
Sewer 3 Feet x 2 Feet.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---------------|---|-----------|--------------------------|------------|------------------------------|------------|-------------------------------------|------------|-----------|------------|--|
| | | One-eighth. (4 1/2 Inches.) | | One-quarter. (3 Inches.) | | One-half. (1 Foot 6 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | | Velocity. | Discharge | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| 1 in | feet per mile | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | gallons |
| 1 in | 66 | 313 | 540 | 404 | 1880 | 510 | 6500 | 574 | 14,900 | 574 | 14,900 | .. |
| 1 " | 100 | 255 | 437 | 322 | 1504 | 414 | 5280 | 467 | 12,120 | 467 | 12,120 | .. |
| 1 " | 132 | 221 | 380 | 286 | 1335 | 361 | 4600 | 407 | 10,550 | 407 | 10,550 | 75 |
| 1 " | 165 | 198 | 338 | 256 | 1200 | 324 | 4130 | 364 | 9,450 | 364 | 9,450 | 100 |
| 1 " | 200 | 180 | 309 | 228 | 1064 | 293 | 3735 | 330 | 8,570 | 330 | 8,570 | 135 |
| 1 " | 264 | 157 | 270 | 202 | 940 | 255 | 3250 | 286 | 7,450 | 286 | 7,450 | 215 |
| 1 " | 330 | 139 | 238 | 180 | 840 | 228 | 2910 | 257 | 6,680 | 257 | 6,680 | 350 |
| 1 " | 440 | 121 | 208 | 156 | 728 | 198 | 2525 | 223 | 5,770 | 223 | 5,770 | 590 |
| 1 " | 528 | 111 | 190 | 143 | 668 | 180 | 2300 | 203 | 5,270 | 203 | 5,270 | 870 |
| 1 " | 660 | 99 | 169 | 128 | 600 | 162 | 2065 | 182 | 4,725 | 182 | 4,725 | 1400 |
| 1 " | 880 | 86 | 147 | 111 | 517 | 140 | 1785 | 157 | 4,075 | 157 | 4,075 | 2800 |
| 1 " | 1056 | 78 | 135 | 101 | 470 | 128 | 1620 | 143 | 3,730 | 143 | 3,730 | .. |
| 1 " | 1320 | 70 | 120 | 90 | 420 | 114 | 1455 | 128 | 3,340 | 128 | 3,340 | .. |
| 1 " | 1760 | 61 | 105 | 78 | 364 | 99 | 1262 | 111 | 2,885 | 111 | 2,885 | .. |

VELOCITY AND DISCHARGE PER MINUTE IN EGG-SHAPED SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Sewer 3 Feet 3 Inches x 2 Feet 2 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|------------|------------------------------|------------|----------------------------------|------------|--|------------|--|
| | One-eighth. (4½ Inches.) | | One-quarter. (9½ Inches.) | | One-half. (1 Foot 7½ Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in 66 | 80 | 326 | 421 | 2300 | 532 | 7975 | 598 | 18,240 | gallons. |
| 1 " 100 | 52.8 | 264 | 341 | 1865 | 432 | 6475 | 490 | 14,935 | " |
| 1 " 132 | 40 | 230 | 298 | 1630 | 376 | 5635 | 423 | 12,870 | 75 |
| 1 " 165 | 32 | 207 | 266 | 1455 | 336 | 5040 | 378 | 11,530 | 100 |
| 1 " 200 | 26.4 | 186 | 241 | 1320 | 304 | 4560 | 344 | 10,490 | 135 |
| 1 " 264 | 20 | 161 | 210 | 1150 | 266 | 3990 | 299 | 9,120 | 220 |
| 1 " 330 | 16 | 143 | 187 | 1023 | 238 | 3565 | 267 | 8,140 | 350 |
| 1 " 440 | 12 | 126 | 164 | 897 | 206 | 3090 | 232 | 7,075 | 590 |
| 1 " 528 | 10 | 115 | 149 | 825 | 187 | 2800 | 211 | 6,435 | 865 |
| 1 " 660 | 8 | 103 | 133 | 727 | 168 | 2520 | 189 | 5,765 | 1390 |
| 1 " 880 | 6 | 89 | 115 | 630 | 145 | 2170 | 163 | 4,940 | 2700 |
| 1 " 1066 | 5 | 81 | 105 | 574 | 133 | 1995 | 150 | 4,560 | 4550 |
| 1 " 1320 | 4 | 71 | 93 | 511 | 119 | 1785 | 133 | 4,065 | " |
| 1 " 1760 | 3 | 63 | 82 | 448 | 103 | 1540 | 116 | 3,540 | " |

VELOCITY AND DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
Sewer 3 Feet 6 Inches x 2 Feet 4 Inches.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|------|---|------------|--|------------|---------------------------------|------------|--|------------|-----------|------------|--|
| | | One-eighth. (8 $\frac{1}{4}$ Inches.) | | One-quarter. (10 $\frac{1}{4}$ Inches.) | | One-half. (1 Foot 3 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| | | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | |
| 1 in | 100 | 275 | 642 | 355 | 2260 | 448 | 7760 | 504 | 17,950 | 504 | 17,950 | gallons |
| 1 " | 132 | 240 | 560 | 300 | 1909 | 390 | 6760 | 440 | 15,660 | 440 | 15,660 | " |
| 1 " | 165 | 214 | 500 | 276 | 1740 | 350 | 6000 | 394 | 14,080 | 394 | 14,080 | 110 |
| 1 " | 200 | 195 | 455 | 251 | 1600 | 317 | 5490 | 357 | 12,700 | 357 | 12,700 | 140 |
| 1 " | 264 | 170 | 396 | 218 | 1370 | 275 | 4780 | 312 | 11,100 | 312 | 11,100 | 220 |
| 1 " | 330 | 152 | 355 | 196 | 1240 | 247 | 4280 | 278 | 9,900 | 278 | 9,900 | 355 |
| 1 " | 440 | 132 | 308 | 170 | 1080 | 215 | 3730 | 243 | 8,600 | 243 | 8,600 | 600 |
| 1 " | 538 | 120 | 280 | 154 | 950 | 195 | 3380 | 230 | 7,830 | 230 | 7,830 | 865 |
| 1 " | 680 | 107 | 250 | 138 | 870 | 175 | 3080 | 197 | 7,015 | 197 | 7,015 | 1380 |
| 1 " | 880 | 93 | 217 | 120 | 760 | 151 | 2620 | 170 | 6,060 | 170 | 6,060 | 2550 |
| 1 " | 1056 | 85 | 198 | 109 | 690 | 138 | 2390 | 157 | 5,500 | 157 | 5,500 | 4200 |
| 1 " | 1320 | 76 | 177 | 98 | 623 | 124 | 2140 | 139 | 4,960 | 139 | 4,960 | " |
| 1 " | 1760 | 66 | 154 | 85 | 540 | 108 | 1870 | 131 | 4,300 | 131 | 4,300 | " |
| 1 " | 2640 | 53 | 124 | 69 | 437 | 87 | 1500 | 96 | 3,510 | 96 | 3,510 | " |

VELOCITY AND DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
Sewer 3 Feet 9 Inches \times 2 Feet 6 Inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|---|------------|-------------------------------|------------|-----------------------------------|------------|--|------------|------|--|--|
| | One-eighth. (5½ Inches.) | | One-quarter. (11¼ Inches.) | | One-half. (1 Foot 10½ Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | | | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in 100 | 284 | 758 | 367 | 2665 | 464 | 9190 | 521 | 21,900 | .. | | |
| 1 " 132 | 40 | 662 | 319 | 2315 | 404 | 8000 | 454 | 18,460 | 80 | | |
| 1 " 165 | 32 | 592 | 286 | 2075 | 360 | 7130 | 405 | 16,470 | 115 | | |
| 1 " 200 | 26-4 | 536 | 260 | 1890 | 328 | 6495 | 369 | 16,000 | 145 | | |
| 1 " 264 | 20 | 467 | 226 | 1640 | 285 | 5645 | 321 | 13,060 | 225 | | |
| 1 " 330 | 16 | 418 | 201 | 1460 | 255 | 5050 | 287 | 11,670 | 360 | | |
| 1 " 440 | 12 | 362 | 175 | 1270 | 221 | 4375 | 249 | 10,135 | 610 | | |
| 1 " 528 | 10 | 331 | 160 | 1160 | 202 | 4000 | 227 | 9,230 | 865 | | |
| 1 " 680 | 8 | 296 | 143 | 1038 | 180 | 3565 | 203 | 8,240 | 1350 | | |
| 1 " 880 | 6 | 256 | 124 | 901 | 156 | 3090 | 176 | 7,155 | 2550 | | |
| 1 " 1056 | 5 | 234 | 113 | 820 | 143 | 2850 | 160 | 6,520 | 3850 | | |
| 1 " 1320 | 4 | 209 | 101 | 730 | 127 | 2525 | 143 | 5,825 | .. | | |
| 1 " 1760 | 3 | 181 | 87 | 635 | 110 | 2188 | 124 | 5,060 | .. | | |
| 1 " 2640 | 2 | 148 | 71 | 515 | 90 | 1782 | 102 | 4,120 | .. | | |

VELOCITY AND DISCHARGE PER MINUTE IN EGG-SHAPED SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Sewer 4 Feet x 2 Feet 8 Inches.

| Inclination. | | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 160 Feet per Minute. |
|--------------|------|---|----------------|---------------------------|-----------------|------------------------|-------------------|--|-------------------|---------|--|--|
| | | One-eighth. (6 Inches.) | | One-quarter. (1 Foot.) | | One-half. (2 Feet.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | | | |
| 1 in | 100 | feet 294 | gallons 884 | feet 380 | gallons 3150 | feet 479 | gallons 10,850 | feet 587 | gallons 25,000 | gallons | | |
| 1 " | 133 | 40 | 255 | 330 | 2740 | 417 | 9,440 | 468 | 21,760 | 80 | | |
| 1 " | 165 | 33 | 226 | 295 | 2450 | 372 | 8,420 | 430 | 19,500 | 120 | | |
| 1 " | 200 | 28.4 | 208 | 268 | 2220 | 339 | 7,675 | 380 | 17,670 | 150 | | |
| 1 " | 264 | 20 | 181 | 234 | 1940 | 295 | 6,680 | 333 | 16,480 | 225 | | |
| 1 " | 330 | 16 | 162 | 208 | 1725 | 264 | 5,980 | 297 | 13,800 | 360 | | |
| 1 " | 440 | 12 | 140 | 180 | 1500 | 228 | 5,160 | 266 | 11,900 | 610 | | |
| 1 " | 528 | 10 | 128 | 165 | 1350 | 208 | 4,720 | 234 | 10,880 | 860 | | |
| 1 " | 660 | 8 | 113 | 148 | 1230 | 186 | 4,210 | 210 | 9,750 | 1350 | | |
| 1 " | 860 | 6 | 99 | 128 | 1065 | 162 | 3,668 | 183 | 8,460 | 2500 | | |
| 1 " | 1056 | 5 | 90 | 117 | 970 | 148 | 3,340 | 168 | 7,720 | 4000 | | |
| 1 " | 1330 | 4 | 81 | 104 | 863 | 132 | 2,990 | 148 | 6,900 | .. | | |
| 1 " | 1760 | 3 | 70 | 90 | 750 | 114 | 2,580 | 128 | 5,860 | .. | | |
| 1 " | 2646 | 2 | 57 | 74 | 615 | 93 | 2,105 | 105 | 4,880 | .. | | |

VELOCITY and DISCHARGE per MINUTE in EGG-SHAPED SEWERS, with Water flowing at various depths.
Sewer 4 Feet 6 Inches \times 3 Feet.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. | | |
|--------------|---|---------|------------|---------|--------------------------------|---------|------------------------------|---------|-------------------------------------|---------|--|------------|--|
| | One-eighth. (6½ Inches.) | | | | One-quarter. (1 Foot 1¼ Inch.) | | One-half. (2 Feet 3 Inches.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in 100 | 314 | 1230 | 402 | 4300 | 508 | 14,540 | 570 | 33,500 | .. | 85 | 370 | | |
| 1 " 133 | 271 | 1050 | 350 | 3740 | 442 | 12,650 | 497 | 29,250 | .. | 85 | 620 | | |
| 1 " 165 | 240 | 925 | 314 | 3360 | 396 | 11,320 | 444 | 26,130 | 125 | 163 | 860 | | |
| 1 " 200 | 223 | 860 | 284 | 3040 | 360 | 10,300 | 405 | 23,830 | 1350 | 2400 | 1350 | | |
| 1 " 264 | 192 | 740 | 248 | 2655 | 312 | 8,930 | 352 | 20,720 | 3550 | 6100 | 3550 | | |
| 1 " 330 | 172 | 664 | 222 | 2375 | 280 | 8,000 | 314 | 18,480 | 6100 | .. | 6100 | | |
| 1 " 440 | 148 | 572 | 192 | 2055 | 242 | 6,920 | 272 | 16,000 | .. | .. | .. | | |
| 1 " 528 | 136 | 525 | 175 | 1870 | 221 | 6,325 | 248 | 14,600 | .. | .. | .. | | |
| 1 " 660 | 120 | 463 | 157 | 1680 | 198 | 5,660 | 222 | 13,060 | .. | .. | .. | | |
| 1 " 880 | 105 | 405 | 136 | 1455 | 171 | 4,700 | 193 | 11,800 | .. | .. | .. | | |
| 1 " 1056 | 96 | 372 | 124 | 1330 | 156 | 4,465 | 176 | 10,360 | .. | .. | .. | | |
| 1 " 1320 | 86 | 334 | 111 | 1190 | 140 | 4,000 | 157 | 9,240 | .. | .. | .. | | |
| 1 " 1760 | 74 | 286 | 96 | 1030 | 121 | 3,460 | 136 | 8,000 | .. | .. | .. | | |
| 1 " 2640 | 60 | 232 | 78 | 840 | 99 | 2,834 | 111 | 6,530 | .. | .. | .. | | |

**VELOCITY AND DISCHARGE PER MINUTE IN EGG-SHAPED SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Sewers 5 Feet x 3 Feet 4 Inches.**

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|------------|---------------------------------|------------|------------------------------|------------|-------------------------------------|------------|--|
| | One-eighth (7½ Inches.) | | One-quarter. (1 Foot 3 Inches.) | | One-half. (2 Feet 6 Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | gallons |
| 1 in 100 | 322 | 1554 | 424 | 5510 | 537 | 19,050 | 600 | 43,550 | .. |
| 1 " 132 | 280 | 1342 | 370 | 4800 | 466 | 16,520 | 523 | 37,900 | 90 |
| 1 " 165 | 252 | 1205 | 332 | 4300 | 418 | 14,800 | 466 | 33,840 | 130 |
| 1 " 200 | 228 | 1092 | 300 | 3890 | 380 | 13,470 | 424 | 30,800 | 165 |
| 1 " 264 | 198 | 950 | 260 | 3370 | 330 | 11,700 | 368 | 26,800 | 250 |
| 1 " 330 | 177 | 848 | 232 | 3000 | 296 | 10,500 | 331 | 24,040 | 380 |
| 1 " 440 | 154 | 738 | 202 | 2620 | 255 | 9,040 | 286 | 20,175 | 630 |
| 1 " 528 | 140 | 670 | 185 | 2400 | 233 | 8,260 | 261 | 18,960 | 865 |
| 1 " 660 | 126 | 603 | 166 | 2150 | 209 | 7,400 | 233 | 16,920 | 1,360 |
| 1 " 880 | 109 | 522 | 143 | 1855 | 181 | 6,420 | 203 | 14,670 | 2,350 |
| 1 " 1056 | 99 | 475 | 130 | 1690 | 165 | 5,850 | 184 | 13,380 | 3,500 |
| 1 " 1320 | 89 | 425 | 116 | 1500 | 148 | 5,250 | 166 | 12,020 | 5,700 |
| 1 " 1760 | 77 | 370 | 101 | 1310 | 127 | 4,500 | 143 | 10,380 | .. |
| 1 " 2640 | 63 | 301 | 83 | 1075 | 104 | 3,700 | 116 | 8,468 | .. |

VELOCITY AND DISCHARGE PER MINUTE IN EGG-SHAPED SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Sewers 6 Feet \times 4 Feet.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | | | | | Quantity required to give Velocity of 150 Feet per Minute. | | |
|--------------|---|---------|------------|---------|------------------------------------|---------|------------------------|---------|--|---------|--|------------|--|
| | One-eighth. (9 Inches.) | | | | One-quarter. (1 Foot 6 Inches.) | | One-half. (3 Feet.) | | Seven-eighths. (Maximum Discharge.) | | | | |
| | Velocity. | | Discharge. | | Velocity. | | Discharge. | | Velocity. | | | Discharge. | |
| | feet | gallons | feet | gallons | feet | gallons | feet | gallons | feet | gallons | | | |
| 1 in 100 | 52.8 | 357 | 2451 | 462 | 8628 | 583 | 29,700 | 664 | 68,410 | .. | 98 | | |
| 1 " 132 | 40 | 313 | 2148 | 401 | 7488 | 510 | 25,984 | 573 | 59,938 | 140 | 140 | | |
| 1 " 165 | 32 | 278 | 1910 | 360 | 6720 | 456 | 23,230 | 512 | 53,560 | 175 | 175 | | |
| 1 " 200 | 26.4 | 254 | 1744 | 327 | 6106 | 414 | 21,093 | 466 | 49,746 | 270 | 270 | | |
| 1 " 264 | 20 | 221 | 1517 | 286 | 5341 | 360 | 18,342 | 406 | 42,366 | 410 | 410 | | |
| 1 " 320 | 16 | 198 | 1359 | 255 | 4762 | 322 | 16,406 | 363 | 37,970 | 640 | 640 | | |
| 1 " 440 | 12 | 171 | 1174 | 221 | 4127 | 279 | 14,215 | 314 | 32,800 | 875 | 875 | | |
| 1 " 528 | 10 | 156 | 1072 | 201 | 3753 | 255 | 12,992 | 286 | 29,917 | 1,380 | 1,380 | | |
| 1 " 660 | 8 | 139 | 954 | 180 | 3361 | 228 | 11,616 | 256 | 26,780 | 2,350 | 2,350 | | |
| 1 " 880 | 6 | 121 | 830 | 156 | 2913 | 197 | 10,037 | 242 | 25,314 | 3,480 | 3,480 | | |
| 1 " 1068 | 5 | 110 | 755 | 143 | 2670 | 180 | 9,171 | 203 | 21,130 | 5,600 | 5,600 | | |
| 1 " 1320 | 4 | 99 | 679 | 127 | 2372 | 161 | 8,203 | 181 | 18,983 | 11,000 | 11,000 | | |
| 1 " 1760 | 3 | 85 | 583 | 110 | 2054 | 140 | 7,130 | 156 | 16,318 | .. | .. | | |
| 1 " 2640 | 2 | 69 | 474 | 90 | 1681 | 114 | 5,800 | 128 | 13,389 | | | | |

TABLE VII.—DISCHARGE OF PIPES (running full).

NOTE.—The velocity in feet per minute may be ascertained in each case by dividing the discharge by the number of gallons contained in each lineal foot of the pipe as given at the top of the column.

| Ratio of Head of Water to Length of Pipe. | Diameter of Pipe. | | | | | | | |
|---|---|---|---|-------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|--|
| | $\frac{1}{8}$ Inch. (.005 Galla. per Ft.) | $\frac{1}{4}$ Inch. (.008 Galla. per Ft.) | $\frac{3}{8}$ Inch. (.019 Galla. per Ft.) | 1 Inch. (.034 Galla. per Ft.) | 1½ Inch. (.063 Galla. per Ft.) | 1¾ Inch. (.076 Galla. per Ft.) | 2 Inches. (.135 Galla. per Ft.) | 2½ Inches. (.212 Galla. per Ft.) |
| 1 to 1 | 2.39 | 4.91 | 13.52 | 27.75 | 48.55 | 76.66 | 137.2 | 274.8 |
| 1 " 2 | 1.70 | 3.47 | 9.56 | 19.63 | 34.82 | 54.23 | 111.2 | 194.4 |
| 1 " 3 | 1.38 | 2.85 | 7.86 | 16.13 | 28.20 | 44.54 | 91.3 | 159.7 |
| 1 " 4 | 1.19 | 2.46 | 6.76 | 13.87 | 24.27 | 38.33 | 78.6 | 137.4 |
| 1 " 5 | 1.07 | 2.20 | 6.05 | 12.40 | 21.70 | 34.28 | 70.3 | 122.8 |
| 1 " 6 | .97 | 2.00 | 5.52 | 11.33 | 19.81 | 31.29 | 64.2 | 112.2 |
| 1 " 7 | .90 | 1.85 | 5.10 | 10.47 | 18.32 | 28.93 | 59.3 | 108.7 |
| 1 " 8 | .85 | 1.73 | 4.78 | 9.81 | 17.15 | 27.09 | 55.5 | 97.1 |
| 1 " 9 | .80 | 1.64 | 4.51 | 9.25 | 16.18 | 25.55 | 52.4 | 91.6 |
| 1 " 10 | .75 | 1.55 | 4.28 | 8.78 | 15.36 | 24.26 | 49.7 | 87.0 |
| 1 " 12 | .69 | 1.42 | 3.91 | 8.02 | 14.30 | 22.16 | 45.4 | 79.4 |
| 1 " 14 | .64 | 1.32 | 3.62 | 7.44 | 13.00 | 20.50 | 42.1 | 73.5 |
| 1 " 16 | .60 | 1.23 | 3.38 | 6.94 | 12.14 | 19.16 | 39.3 | 68.7 |
| 1 " 18 | .56 | 1.17 | 3.19 | 6.53 | 11.44 | 18.10 | 37.1 | 64.8 |
| 1 " 20 | .53 | 1.10 | 3.03 | 6.21 | 10.85 | 17.15 | 35.2 | 61.3 |

DISCHARGE OF PIPES (running full).

NOTE.—The velocity in feet per minute may be ascertained in each case by dividing the discharge by the number of gallons contained in each lineal foot of the pipe as given at the top of the column.

| Ratio of Head of Water to Length of Pipe. | Diameter of Pipe. | | | | | | | | | |
|---|---|---|---|-------------------------------------|---|-------------------------------------|---|-------------------------------------|-----------------|-----------------|
| | $\frac{1}{8}$ Inch. (.005 Galla. per Ft.) | $\frac{1}{4}$ Inch. (.008 Galla. per Ft.) | $\frac{3}{8}$ Inch. (.019 Galla. per Ft.) | 1 Inch. (.034 Galla. per Ft.) | 1 $\frac{1}{2}$ Inch. (.053 Galla. per Ft.) | 2 Inch. (.076 Galla. per Ft.) | 2 $\frac{1}{2}$ Inch. (.135 Galla. per Ft.) | 3 Inch. (.212 Galla. per Ft.) | | |
| | galla. per min. | galla. per min. | galla. per min. | galla. per min. | galla. per min. | galla. per min. | galla. per min. | galla. per min. | galla. per min. | galla. per min. |
| 1 to 25 | .48 | .98 | 2.71 | 5.55 | 9.70 | 15.33 | 31.4 | 55.0 | | |
| 1 " 30 | .44 | .90 | 2.48 | 5.08 | 8.90 | 14.05 | 29.3 | 50.0 | | |
| 1 " 35 | .40 | .83 | 2.28 | 4.69 | 8.20 | 12.95 | 26.5 | 46.4 | | |
| 1 " 40 | .38 | .78 | 2.14 | 4.40 | 7.70 | 12.12 | 24.9 | 43.4 | | |
| 1 " 45 | .36 | .73 | 2.02 | 4.14 | 7.23 | 11.42 | 23.4 | 41.0 | | |
| 1 " 50 | .33 | .69 | 1.92 | 3.93 | 6.86 | 10.80 | 22.2 | 38.9 | | |
| 1 " 60 | .31 | .64 | 1.76 | 3.60 | 6.30 | 9.90 | 20.4 | 35.6 | | |
| 1 " 70 | .28 | .59 | 1.62 | 3.32 | 5.80 | 9.16 | 18.8 | 32.8 | | |
| 1 " 80 | .27 | .55 | 1.50 | 3.10 | 5.40 | 8.60 | 17.5 | 30.7 | | |
| 1 " 100 | .24 | .49 | 1.34 | 2.77 | 4.86 | 7.66 | 15.7 | 27.5 | | |
| 1 " 120 | .21 | .44 | 1.23 | 2.52 | 4.40 | 6.95 | 14.3 | 24.9 | | |
| 1 " 150 | .19 | .40 | 1.11 | 2.27 | 3.96 | 6.26 | 12.8 | 22.4 | | |
| 1 " 200 | .17 | .35 | .96 | 1.96 | 3.43 | 5.42 | 11.1 | 19.4 | | |
| 1 " 250 | .15 | .31 | .85 | 1.75 | 3.07 | 4.85 | 9.9 | 17.4 | | |
| 1 " 300 | .14 | .29 | .79 | 1.61 | 2.82 | 4.45 | 9.1 | 16.0 | | |

DISCHARGE OF PIPES (running full).

NOTE.—The velocity in feet per minute may be ascertained in each case by dividing the discharge by the number of gallons contained in each lineal foot of the pipe as given at the top of the column.

| Ratio of Head of Water to Length of Pipe. | Diameter of Pipe. | | | | | | | | | |
|---|--------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|--|--|
| | 3 Inches. (308 Galls. per Ft.) | 4 Inches. (54 Galls. per Ft.) | 5 Inches. (86 Galls. per Ft.) | 6 Inches. (122 Galls. per Ft.) | 7 Inches. (166 Galls. per Ft.) | 8 Inches. (217 Galls. per Ft.) | 9 Inches. (276 Galls. per Ft.) | 10 Inches. (346 Galls. per Ft.) | | |
| 1 to 5 | galls. per min. 193 | galls. per min. 388 | galls. per min. 695 | galls. per min. 1097 | galls. per min. 1613 | galls. per min. 2253 | galls. per min. 3020 | galls. per min. 3833 | | |
| 1 " 10 | 137 | 281 | 491 | 776 | 1140 | 1592 | 2138 | 2780 | | |
| 1 " 15 | 112 | 230 | 401 | 633 | 931 | 1300 | 1745 | 2270 | | |
| 1 " 20 | 97 | 199 | 347 | 548 | 806 | 1126 | 1511 | 1967 | | |
| 1 " 25 | 86 | 178 | 311 | 491 | 721 | 1007 | 1352 | 1759 | | |
| 1 " 30 | 79 | 162 | 283 | 448 | 658 | 920 | 1234 | 1606 | | |
| 1 " 35 | 73 | 150 | 263 | 415 | 610 | 851 | 1142 | 1487 | | |
| 1 " 40 | 68 | 141 | 246 | 388 | 570 | 796 | 1069 | 1391 | | |
| 1 " 45 | 64 | 133 | 232 | 366 | 538 | 751 | 1007 | 1311 | | |
| 1 " 50 | 61 | 126 | 222 | 347 | 510 | 712 | 956 | 1244 | | |
| 1 " 60 | 56 | 115 | 201 | 317 | 466 | 650 | 873 | 1136 | | |
| 1 " 70 | 52 | 106 | 186 | 293 | 431 | 594 | 808 | 1051 | | |
| 1 " 80 | 49 | 99 | 174 | 274 | 403 | 563 | 756 | 983 | | |
| 1 " 90 | 46 | 94 | 164 | 258 | 380 | 536 | 712 | 927 | | |
| 1 " 100 | 43 | 89 | 155 | 245 | 360 | 503 | 676 | 879 | | |

DISCHARGE OF PIPES (running full).

NOTE.—The velocity in feet per minute may be ascertained in each case by dividing the discharge by the number of gallons contained in each lineal foot of the pipe as given at the top of the column.

| Ratio of Head of Water to Length of Pipe. | Diameter of Pipe. | | | | | | | |
|---|---------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--|
| | 3 Inches. (.305 Galla. per Ft.) | 4 Inches. (.54 Galla. per Ft.) | 5 Inches. (.85 Galla. per Ft.) | 6 Inches. (1.22 Galla. per Ft.) | 7 Inches. (1.66 Galla. per Ft.) | 8 Inches. (2.17 Galla. per Ft.) | 9 Inches. (2.76 Galla. per Ft.) | 10 Inches. (3.38 Galla. per Ft.) |
| 1 " 125 | 39 | 80 | 139 | 219 | 323 | 450 | 605 | 786 |
| 1 " 150 | 36 | 73 | 127 | 200 | 296 | 411 | 552 | 718 |
| 1 " 175 | 33 | 67 | 117 | 183 | 273 | 380 | 510 | 665 |
| 1 " 200 | 31 | 62 | 109 | 173 | 262 | 352 | 478 | 622 |
| 1 " 250 | 27 | 56 | 98 | 154 | 227 | 317 | 426 | 554 |
| 1 " 300 | 25 | 51 | 90 | 142 | 208 | 291 | 390 | 508 |
| 1 " 350 | 23 | 47 | 83 | 131 | 193 | 270 | 361 | 470 |
| 1 " 400 | 21 | 44 | 78 | 123 | 180 | 252 | 338 | 440 |
| 1 " 450 | 20 | 42 | 73 | 116 | 170 | 238 | 319 | 415 |
| 1 " 500 | 19 | 40 | 69 | 110 | 161 | 225 | 302 | 393 |
| 1 " 600 | 18 | 36 | 63 | 100 | 147 | 206 | 276 | 360 |
| 1 " 700 | 17 | 34 | 59 | 93 | 136 | 191 | 256 | 332 |
| 1 " 800 | 16 | 31 | 55 | 87 | 127 | 178 | 239 | 320 |
| 1 " 900 | 15 | 29 | 52 | 82 | 120 | 168 | 226 | 293 |
| 1 " 1000 | 14 | 28 | 49 | 78 | 114 | 159 | 214 | 278 |

DISCHARGE OF PIPES (running full).

NOTE.—The velocity in feet per minute may be ascertained in each case by dividing the discharge by the number of gallons contained in each lineal foot of the pipe as given at the top of the column.

| Ratio of Head of Water to Length of Pipe. | Diameter of Pipe. | | | | | | | |
|---|---------------------------------------|--|---|-------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | 12 Inches. (4.9) Gall. per Ft.) | 15 Inches. (7.67) Gall. per Ft.) | 18 Inches. (11.04) Gall. per Ft.) | 21 Inches. (15 Gall. per Ft.) | 24 Inches. (19.6 Gall. per Ft.) | 27 Inches. (24.8 Gall. per Ft.) | 30 Inches. (30.7 Gall. per Ft.) | 36 Inches. (44.2 Gall. per Ft.) |
| 1 to 20 | 3,103 | 5,420 | 8,551 | 12,570 | 17,552 | 23,360 | 30,660 | 48,365 |
| 1 " 25 | 2,775 | 4,848 | 7,648 | 11,240 | 15,698 | 21,070 | 27,422 | 43,265 |
| 1 " 30 | 2,533 | 4,426 | 6,982 | 10,262 | 14,390 | 19,235 | 25,034 | 39,490 |
| 1 " 40 | 2,194 | 3,853 | 6,047 | 8,888 | 12,411 | 16,660 | 21,680 | 34,200 |
| 1 " 50 | 1,962 | 3,428 | 5,408 | 7,950 | 11,100 | 14,900 | 19,390 | 30,588 |
| 1 " 60 | 1,792 | 3,130 | 4,937 | 7,257 | 10,133 | 13,600 | 17,704 | 27,926 |
| 1 " 70 | 1,660 | 2,897 | 4,571 | 6,717 | 9,382 | 12,593 | 16,390 | 25,854 |
| 1 " 80 | 1,551 | 2,710 | 4,276 | 6,284 | 8,776 | 11,943 | 15,330 | 24,182 |
| 1 " 90 | 1,462 | 2,555 | 4,032 | 5,925 | 8,274 | 11,105 | 14,452 | 22,000 |
| 1 " 100 | 1,387 | 2,424 | 3,824 | 5,621 | 7,860 | 10,535 | 13,712 | 21,628 |
| 1 " 125 | 1,241 | 2,168 | 3,420 | 5,027 | 7,021 | 9,423 | 12,264 | 19,346 |
| 1 " 150 | 1,133 | 1,980 | 3,123 | 4,591 | 6,411 | 8,605 | 11,200 | 17,665 |
| 1 " 175 | 1,049 | 1,832 | 2,890 | 4,250 | 5,933 | 7,964 | 10,365 | 16,350 |
| 1 " 200 | 981 | 1,714 | 2,698 | 3,974 | 5,538 | 7,450 | 9,695 | 15,294 |
| 1 " 250 | 874 | 1,527 | 2,410 | 3,542 | 4,946 | 6,688 | 8,640 | 13,628 |

DISCHARGE OF PIPES (running full).

NOTE.—The velocity in feet per minute may be ascertained in each case by dividing the discharge by the number of gallons contained in each lineal foot of the pipe as given at the top of the column.

| Ratio of Head of Water to Length of Pipe. | Diameter of Pipe. | | | | | | | | | |
|---|--|--|--|--------------------------------------|--|--|--|--|--|--|
| | 12 Inches. (4.91 Galls. per Ft.) | 15 Inches. (7.67 Galls. per Ft.) | 18 Inches. 11.04 Galls. per Ft.) | 21 Inches. (15 Galls. per Ft.) | 24 Inches. (19.6 Galls. per Ft.) | 27 Inches. (24.8 Galls. per Ft.) | 30 Inches. (30.7 Galls. per Ft.) | 36 Inches. (44.2 Galls. per Ft.) | | |
| 1 to 300 | 801 | 1,400 | 2,208 | 3,245 | 4,532 | 6,083 | 7,916 | 12,488 | | |
| 1 " 350 | 742 | 1,296 | 2,044 | 3,004 | 4,196 | 5,567 | 7,330 | 11,560 | | |
| 1 " 400 | 694 | 1,212 | 1,912 | 2,810 | 3,925 | 5,268 | 6,856 | 10,814 | | |
| 1 " 450 | 654 | 1,143 | 1,803 | 2,650 | 3,700 | 4,966 | 6,464 | 10,198 | | |
| 1 " 500 | 620 | 1,084 | 1,710 | 2,514 | 3,510 | 4,712 | 6,132 | 9,675 | | |
| 1 " 600 | 566 | 990 | 1,561 | 2,295 | 3,204 | 4,300 | 5,597 | 8,830 | | |
| 1 " 700 | 524 | 916 | 1,415 | 2,124 | 2,971 | 3,982 | 5,182 | 8,174 | | |
| 1 " 800 | 490 | 857 | 1,352 | 1,987 | 2,775 | 3,725 | 4,848 | 7,647 | | |
| 1 " 900 | 462 | 808 | 1,275 | 1,873 | 2,616 | 3,512 | 4,570 | 7,240 | | |
| 1 " 1000 | 439 | 766 | 1,210 | 1,777 | 2,482 | 3,332 | 4,336 | 6,840 | | |
| 1 " 1250 | 392 | 684 | 1,081 | 1,590 | 2,220 | 2,980 | 3,878 | 6,118 | | |
| 1 " 1500 | 358 | 627 | 987 | 1,451 | 2,027 | 2,720 | 3,540 | 5,585 | | |
| 1 " 2000 | 310 | 542 | 855 | 1,257 | 1,755 | 2,356 | 3,066 | 4,836 | | |
| 1 " 3000 | 253 | 443 | 698 | 1,026 | 1,433 | 1,924 | 2,503 | 3,949 | | |
| 1 " 5000 | 196 | 343 | 541 | 795 | 1,110 | 1,490 | 1,939 | 3,059 | | |

TABLE VIII.—QUANTITY OF SEWAGE due to POPULATION.

| Population. | Average Flow during 24 hours. | | | | Maximum Flow, half in 6 hours. | | | | Allowance for Rainfall for Population of 100 per acre, or 432 super. feet of area per inhabitant. | | | |
|-------------|-------------------------------|-----------------|------------------------|-----------------|--------------------------------|-----------------|------------------------|-----------------|---|-----------------|------------------------|-----------------|
| | At 20 Galls. per Head. | | At 30 Galls. per Head. | | At 50 Galls. per Head. | | At 20 Galls. per Head. | | At 30 Galls. per Head. | | At 50 Galls. per Head. | |
| | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. |
| 500 | 7 | 10 | 17 | 14 | 21 | 35 | 14 | 21 | 35 | 19.6 | 39.3 | 78.7 |
| 1,000 | 14 | 21 | 35 | 28 | 42 | 69 | 28 | 42 | 69 | 39 | 79 | 157 |
| 2,000 | 28 | 42 | 69 | 56 | 83 | 139 | 56 | 83 | 139 | 79 | 157 | 315 |
| 3,000 | 42 | 62 | 104 | 83 | 125 | 208 | 83 | 125 | 208 | 118 | 236 | 472 |
| 4,000 | 56 | 83 | 139 | 111 | 167 | 278 | 111 | 167 | 278 | 157 | 315 | 629 |
| 5,000 | 69 | 104 | 174 | 139 | 208 | 347 | 139 | 208 | 347 | 196 | 393 | 787 |
| 6,000 | 83 | 125 | 208 | 167 | 250 | 417 | 167 | 250 | 417 | 235 | 472 | 944 |
| 7,000 | 97 | 146 | 243 | 194 | 292 | 486 | 194 | 292 | 486 | 275 | 551 | 1,101 |
| 8,000 | 111 | 167 | 278 | 222 | 338 | 556 | 222 | 338 | 556 | 314 | 630 | 1,258 |
| 9,000 | 125 | 187 | 312 | 250 | 375 | 625 | 250 | 375 | 625 | 353 | 708 | 1,416 |
| 10,000 | 139 | 208 | 347 | 278 | 417 | 694 | 278 | 417 | 694 | 393 | 787 | 1,573 |
| 20,000 | 278 | 417 | 694 | 555 | 833 | 1,389 | 555 | 833 | 1,389 | 787 | 1,573 | 3,146 |
| 30,000 | 416 | 625 | 1,041 | 833 | 1,250 | 2,083 | 833 | 1,250 | 2,083 | 1,179 | 2,358 | 4,717 |
| 40,000 | 555 | 833 | 1,389 | 1,110 | 1,667 | 2,778 | 1,110 | 1,667 | 2,778 | 1,573 | 3,146 | 6,292 |
| 50,000 | 694 | 1,042 | 1,736 | 1,389 | 2,083 | 3,472 | 1,389 | 2,083 | 3,472 | 1,966 | 3,932 | 7,865 |

QUANTITY OF SEWAGE due to POPULATION.

| Population. | Average Flow during 24 hours. | | | | Maximum Flow, half in 6 hours. | | | | Allowance for Rainfall for Population of 100 per acre, or 435 super. feet of area per inhabitant. | | | |
|-------------|-------------------------------|-----------------|------------------------|-----------------|--------------------------------|-----------------|------------------------|-----------------|---|-----------------|------------------------------------|-----------------|
| | At 20 Galls. per Head. | | At 30 Galls. per Head. | | At 40 Galls. per Head. | | At 50 Galls. per Head. | | At $\frac{1}{2}$ Inch in 24 Hours. | | At $\frac{1}{4}$ Inch in 24 Hours. | |
| | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. |
| 60,000 | 833 | 1,250 | 1,666 | 2,083 | 2,500 | 2,916 | 3,333 | 3,750 | 2,358 | 4,717 | 9,434 | 11,009 |
| 70,000 | 972 | 1,458 | 1,944 | 2,430 | 2,860 | 3,384 | 3,909 | 4,434 | 2,652 | 5,304 | 10,608 | 12,584 |
| 80,000 | 1,110 | 1,667 | 2,220 | 2,778 | 3,333 | 3,909 | 4,434 | 4,959 | 3,146 | 6,292 | 12,584 | 14,157 |
| 90,000 | 1,250 | 1,875 | 2,500 | 3,125 | 3,750 | 4,434 | 5,109 | 5,784 | 3,539 | 7,079 | 14,157 | 15,729 |
| 100,000 | 1,389 | 2,083 | 2,778 | 3,472 | 4,166 | 4,959 | 5,750 | 6,544 | 3,982 | 7,965 | 15,930 | 17,906 |

250 gallons per inhabited house, being about 44 gallons per head, is the quantity prescribed by Act of Parliament to be provided for in the Lower Thames Valley and Darent Valley Main Sewerage Districts. This is understood to include some allowance for rainfall.

Rainfall should not be taken on the basis of population, as in the third column, unless *either* the whole area to be provided for is continuously built upon, *or* the separate system is adopted and rain not admitted to the sewers except in close proximity to houses.

In the former case, if the population be greater than is assumed, the figures in the Table must obviously be *divided* by the ratio to 100; thus, for population of 200 per acre divide by 2, for 150 per acre take two-thirds, &c., and similarly for 50 per acre multiply by 2, &c.

On the other hand, if the system to be adopted is that of excluding the rain water, the average area pertaining to each inhabited house must first be ascertained and the number of persons per house; and the figures in the third column may be adopted or will require modification, according as the result arrived at compares with the assumption of 435 super feet to each individual.

TABLE IX.—QUANTITY AND DISCHARGE FROM AREAS due to RAINFALL.

| Area. | Quantity equal to 1 Inch of Rain over Surface. | Equivalent Supply Daily throughout the Year. | Quantity running off at following Rates. | | | | | | | |
|---------------|--|--|--|--------------------------------|--------------------------------|--------------------------------|---------------------|---------------------------------|---------------------------------|---------------------------------|
| | | | 1 Inch in an hour. | $\frac{1}{2}$ Inch in an hour. | $\frac{1}{4}$ Inch in an hour. | $\frac{1}{8}$ Inch in an hour. | 1 Inch in 24 hours. | $\frac{1}{2}$ Inch in 24 hours. | $\frac{1}{4}$ Inch in 24 hours. | $\frac{1}{8}$ Inch in 24 hours. |
| | gallons | gallons | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. |
| 100 sup. feet | 52 | 0.14 | 0.87 | 0.43 | 0.22 | 0.11 | 0.036 | 0.018 | 0.009 | 0.005 |
| 200 " | 104 | 0.28 | 1.74 | 0.87 | 0.43 | 0.22 | 0.072 | 0.036 | 0.018 | 0.009 |
| 300 " | 156 | 0.43 | 2.60 | 1.30 | 0.65 | 0.32 | 0.108 | 0.054 | 0.027 | 0.013 |
| 400 " | 208 | 0.57 | 3.47 | 1.74 | 0.87 | 0.43 | 0.144 | 0.072 | 0.036 | 0.018 |
| 500 " | 260 | 0.71 | 4.34 | 2.17 | 1.08 | 0.54 | 0.181 | 0.090 | 0.045 | 0.022 |
| 1,000 " | 520 | 1.4 | 8.7 | 4.3 | 2.2 | 1.1 | 0.36 | 0.18 | 0.09 | 0.05 |
| 2,000 " | 1,040 | 2.8 | 17.4 | 8.7 | 4.3 | 2.2 | 0.72 | 0.36 | 0.18 | 0.09 |
| 3,000 " | 1,560 | 4.3 | 26.0 | 13.0 | 6.5 | 3.2 | 1.08 | 0.54 | 0.27 | 0.13 |
| 4,000 " | 2,080 | 5.7 | 34.7 | 17.4 | 8.7 | 4.3 | 1.44 | 0.72 | 0.36 | 0.18 |
| 5,000 " | 2,600 | 7.1 | 43.4 | 21.7 | 10.8 | 5.4 | 1.81 | 0.90 | 0.45 | 0.22 |
| 10,000 " | 5,200 | 14.2 | 86.8 | 43.4 | 21.7 | 10.8 | 3.62 | 1.81 | 0.90 | 0.45 |
| 1 acre | 22,651 | 62 | 877 | 189 | 94 | 47 | 15.7 | 7.9 | 3.9 | 2.0 |
| 2 acres | 45,302 | 124 | 755 | 377 | 189 | 94 | 31.5 | 15.7 | 7.9 | 3.9 |
| 3 " | 67,954 | 186 | 1,132 | 566 | 284 | 142 | 47.2 | 23.6 | 11.8 | 5.9 |
| 4 " | 90,605 | 248 | 1,510 | 755 | 378 | 189 | 63.0 | 31.5 | 15.7 | 7.9 |
| 5 " | 113,256 | 310 | 1,887 | 944 | 472 | 236 | 78.7 | 39.3 | 19.6 | 9.8 |

QUANTITY AND DISCHARGE from AREAS due to RAINFALL.

| Area. | Quantity equal to 1 Inch of Rain over Surface. | Equivalent Supply Daily throughout the Year. | Quantity running off at following Rates. | | | | | | | |
|---------------|--|--|--|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | | | 1 Inch in an hour. | ½ Inch in an hour. | ¼ Inch in an hour. | 1 Inch in 24 hours. | ½ Inch in 24 hours. | ¼ Inch in 24 hours. | 1 Inch in 24 hours. | ½ Inch in 24 hours. |
| | | | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. | galls. per min. |
| 10 acres | 226,512 | 620 | 3,775 | 1,888 | 944 | 472 | 157 | 79 | 39 | 20 |
| 20 " | 453,025 | 1,241 | 7,550 | 3,775 | 1,888 | 944 | 315 | 157 | 79 | 39 |
| 30 " | 679,537 | 1,862 | 11,326 | 5,663 | 2,831 | 1,415 | 472 | 236 | 118 | 59 |
| 40 " | 906,049 | 2,482 | 15,101 | 7,550 | 3,776 | 1,888 | 629 | 315 | 157 | 79 |
| 50 " | 1,132,561 | 3,103 | 18,876 | 9,438 | 4,719 | 2,360 | 787 | 393 | 196 | 98 |
| 100 " | 2,265,122 | 6,206 | 37,752 | 18,876 | 9,438 | 4,719 | 1,573 | 787 | 393 | 196 |
| 200 " | 4,530,245 | 12,412 | 75,504 | 37,752 | 18,876 | 9,438 | 3,146 | 1,573 | 787 | 393 |
| 300 " | 6,795,367 | 18,618 | 113,256 | 56,628 | 28,314 | 14,152 | 4,717 | 2,358 | 1,179 | 589 |
| 400 " | 9,060,490 | 24,823 | 151,008 | 75,504 | 37,752 | 18,876 | 6,292 | 3,145 | 1,573 | 787 |
| 500 " | 11,325,612 | 31,029 | 188,760 | 94,380 | 47,190 | 23,595 | 7,865 | 3,932 | 1,966 | 983 |
| 1 square mile | 14,496,770 | 39,717 | 241,613 | 120,806 | 60,403 | 30,201 | 10,067 | 5,033 | 2,516 | 1,258 |

It is estimated that on an average four-fifths of the Rain runs off slated roofs, one-half off streets and paved surfaces; and one-eighth part off the surface of cultivated land, within an hour of falling, whenever the fall is considerable.

TABLE X.—ANNUAL RAINFALL.
Average Rainfall for 30 Years (1870–1899) in British Isles.

| Division. | County. | Station. | Height above Sea. | Average Rainfall. |
|-----------|------------------|-----------------------------------|-------------------------|----------------------|
| | ENGLAND. | | ft. | in. |
| I. | Middlesex .. | London (Camden Square) | 111 | 25·16 |
| II. | Surrey | Reigate (Nutwood) | 440 | 30·11 |
| | Kent | Selling (Harefield) | 217 | 29·55 |
| | Sussex | Eastbourne (Osborne House) .. | 12 | 30·98 |
| | Hants | Osborne (Newbarn Cottage) .. | 172 | 28·12 |
| | " | Alton (Ashdell) | 433 | 33·20 |
| III. | Herts | Hitchin (Wratten) | 238 | 24·66 |
| | Bucks | High Wycombe | 253 | 24·93 |
| | Oxford | Oxford (Magdalen College) .. | 186 | 24·54 |
| | Northampton .. | Wellingboro (Croyland Abbey) .. | 160 | 25·31 |
| | Cambridge .. | Ely (Stretham) | 42 | 22·16 |
| IV. | Essex | Chelmsford (High Street) | 86 | 22·96 |
| | Suffolk | Ixworth (Walsham-le-Willows) .. | — | 25·87 |
| | Norfolk | Geldeston | 38 | 23·93 |
| | " | Hillington School | 94 | 27·17 |
| V. | Wilts | Marlborough (Mildenhall) | 456 | 30·19 |
| | Dorset | Wimborne Minster (Chalbury) .. | 338 | 31·06 |
| | Devon | Ashburton (Druid House) | 572 | 52·91 |
| | " | Barnstaple (Athenæum) | 25 | 38·32 |
| | Cornwall | St. Austell (Trevarna) | 300 | 47·16 |
| | Somerset | E. Harptree (Sherborne Reservoir) | 338 | 41·16 |
| VI. | Hereford | Ross (The Graig) | 213 | 29·51 |
| | " | Kington (Lynhales) | 566 | 33·56 |
| | Salop | Church Stretton (Woolstaston) .. | 800 | 33·04 |
| | " | Adderley Rectory | 277 | 29·13 |
| | Stafford | Burton (Rangemoor) | 424 | 28·01 |
| | Worcester | Northwick Park | 410 | 29·22 |
| VII. | Leicester | Thornton Reservoir | 371 | 26·48 |
| | Lincoln | Horncastle (Revesby) | 135 | 24·77 |
| | Notts | Worksop | 56 | 24·54 |
| VIII. | Cheshire | Woodhead Reservoir | 660 | 48·85 |
| | Lancashire | Ormskirk (Ruford) | 39 | 33·71 |
| | " | Cartmel (Holker) | 155 | 43·69 |
| IX. | York, W. Riding | South Milford Rectory | 70 | 26·08 |
| | " " " | Arcliffe Vicarage | 734 | 60·96 |
| | " E. " | Hull (Pearson Park) | 6 | 27·02 |
| | " N. " | Old Malton | 75 | 26·71 |
| | " " " | Bedale (Thorpe Perrow) | 170 | 27·09 |

TABLE X.—*continued.*

| Division. | County. | Station. | Height above Sea. | Average Rainfall. |
|-----------|-----------------------|---------------------------------|-------------------------|----------------------|
| | ENGLAND— <i>cont.</i> | | ft. | in. |
| X. | Durham | Wolsingham | 464 | 34·75 |
| | Northumberland | Haltwhistle (Unthank Hall) .. | 380 | 35·44 |
| | " | Ilderton (Lilburn Tower) .. | 300 | 29·19 |
| | Cumberland .. | Whitehaven (Irish Street) .. | 21 | 41·29 |
| | " | Carlisle (Cemetery) | 114 | 31·64 |
| | Westmorland .. | Kendal (Ivy Garth) | 146 | 50·41 |
| | WALES. | | | |
| XI. | Pembroke | Haverfordwest (High Street) .. | 95 | 47·88 |
| | Carnarvon .. | Llanystumdwy (Salarvor) .. | 49 | 35·82 |
| | " | Llandudno (Warwick House) .. | 90 | 30·98 |
| | SCOTLAND. | | | |
| XII. | Dumfries | Durrisdeer (Drumlanrig Castle) | 191 | 44·28 |
| XIII. | Selkirk | Galashiels (Abbotsford Road) .. | 416 | 33·82 |
| | Berwick | Marchmont House | 500 | 34·91 |
| XIV. | Lanark | Bothwell Castle | 146 | 28·92 |
| | Ayr | Girvan (Pinmore) | 187 | 48·87 |
| | Renfrew | Waulk Glen | 280 | 46·91 |
| XVI. | Kinross | Loch Leven Sluice | 360 | 36·20 |
| | Perth | Loch Drunkie | 420 | 63·09 |
| | Forfar | Craigton | 481 | 37·73 |
| XVII. | Aberdeen | Braemar | 1114 | 36·07 |
| | Elgin or Moray | Gordon Castle | 107 | 30·41 |
| XVIII. | Inverness | Loch Shiel (Glenaladale) .. | 50 | 105·29 |
| XIX. | Sutherland .. | Golspie (Dunrobin Castle) .. | 14 | 31·03 |
| | IRELAND. | | | |
| XX. | Waterford | Portlaw (Mayfield) | 70 | 42·38 |
| XXI. | Wexford | Gorey (Courtown House) .. | 80 | 35·72 |
| | Wicklow | Bray (Fassaroe) | 250 | 40·55 |
| | Carlow | Carlow (Browne's Hill) .. | 291 | 34·44 |
| XXII. | Galway | Ballinasloe | 160 | 37·04 |
| XXIII. | Cavan | Belturbet (Red Hills) .. | 208 | 35·19 |
| | Armagh | Armagh Observatory | 205 | 31·36 |
| | Down | Seaforde | 180 | 38·61 |
| | Tyrone | Omagh (Edenfel) | 280 | 37·85 |

TABLE XI.—MONTHLY AND ANNUAL RAINFALL.

(1) Rainfall at Camden Square, London, during each Month for 42 Years, 1858-1899.

| Year. | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|-------|------|------|------|-------|------|------|------|------|-------|------|------|------|--------|
| | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. |
| 1858 | ·88 | 1·80 | ·69 | 2·90 | 2·76 | ·92 | 3·01 | 1·10 | ·85 | 1·58 | ·53 | 1·75 | 18·77 |
| 1859 | ·72 | 1·23 | 1·33 | 2·61 | 2·13 | 2·90 | 2·93 | 2·65 | 4·04 | 2·53 | 2·90 | 2·24 | 28·21 |
| 1860 | 1·97 | 1·25 | 1·87 | 1·45 | 3·57 | 5·47 | 2·26 | 4·48 | 2·92 | 1·77 | 2·72 | 2·51 | 32·24 |
| 1861 | ·43 | 1·93 | 2·43 | 1·30 | 1·39 | 2·13 | 2·42 | ·94 | 2·15 | 1·05 | 4·65 | 1·45 | 22·27 |
| 1862 | 1·92 | ·31 | 3·69 | 2·30 | 3·06 | 2·43 | 2·61 | 2·74 | 2·19 | 3·50 | 1·13 | 1·71 | 27·59 |
| 1863 | 2·80 | ·67 | ·85 | ·52 | 1·27 | 4·86 | ·92 | 1·44 | 3·49 | 1·62 | 1·84 | 1·31 | 21·59 |
| 1864 | 1·02 | ·85 | 2·62 | ·82 | 1·86 | 1·28 | ·62 | 1·33 | 2·55 | 1·13 | 2·49 | ·36 | 16·93 |
| 1865 | 3·90 | 2·01 | 1·12 | ·33 | 3·40 | 2·21 | 2·33 | 4·10 | ·55 | 6·22 | 1·96 | 1·35 | 29·48 |
| 1866 | 3·90 | 3·72 | 1·69 | 1·76 | 2·03 | 3·98 | 1·19 | 2·76 | 3·89 | 2·32 | 1·73 | 2·63 | 31·60 |
| 1867 | 2·81 | 1·44 | 2·48 | 2·36 | 2·45 | 1·22 | 4·30 | 2·63 | 2·23 | 1·92 | ·86 | 1·59 | 26·29 |
| 1868 | 3·89 | 1·21 | 1·28 | 1·50 | 1·58 | ·78 | ·45 | 2·28 | 1·74 | 2·54 | 1·03 | 5·12 | 23·40 |
| 1869 | 2·76 | 2·48 | 1·97 | 1·28 | 3·27 | 1·03 | ·62 | 1·26 | 3·56 | 1·87 | 2·38 | 2·94 | 25·42 |
| 1870 | 1·38 | 1·21 | 2·31 | ·47 | ·70 | ·83 | 1·22 | 2·69 | 2·00 | 3·68 | 1·76 | 3·07 | 21·32 |
| 1871 | 1·99 | 1·27 | 1·19 | 2·84 | ·92 | 3·49 | 4·12 | ·85 | 5·28 | 1·34 | ·60 | 1·13 | 25·02 |
| 1872 | 3·46 | ·96 | 2·66 | 1·39 | 3·05 | 2·55 | 2·57 | 2·05 | 1·64 | 5·20 | 3·98 | 4·35 | 33·86 |
| 1873 | 2·44 | 1·96 | 1·46 | ·55 | 1·56 | 2·24 | 2·81 | 2·87 | 2·46 | 2·97 | 1·87 | ·48 | 22·67 |
| 1874 | 1·18 | ·91 | ·39 | 1·26 | 1·14 | 2·05 | ·82 | 1·32 | 2·62 | 3·34 | 2·21 | 1·58 | 18·82 |
| 1875 | 3·22 | 1·06 | ·69 | 1·53 | 1·61 | 2·40 | 4·63 | 1·79 | 2·86 | 4·35 | 3·36 | ·94 | 28·44 |
| 1876 | ·94 | 1·97 | 2·96 | 1·90 | ·94 | 1·27 | ·81 | 1·79 | 2·86 | 1·40 | 3·07 | 6·25 | 26·16 |
| 1877 | 4·74 | 1·78 | 2·38 | 2·59 | 1·91 | ·42 | 3·94 | 2·23 | ·82 | 1·97 | 3·88 | 1·51 | 28·17 |
| 1878 | 1·31 | 1·49 | 1·12 | 4·97 | 3·89 | 6·71 | ·64 | 6·72 | ·83 | 1·99 | 2·95 | 1·46 | 34·08 |
| 1879 | 2·87 | 3·77 | ·91 | 2·72 | 3·46 | 4·76 | 4·17 | 5·11 | 3·67 | ·80 | ·72 | ·86 | 33·82 |
| 1880 | ·31 | 2·33 | ·79 | 2·15 | ·26 | 4·04 | 5·11 | ·45 | 4·04 | 5·78 | 1·85 | 3·17 | 30·28 |
| 1881 | 1·85 | 3·09 | 2·30 | ·46 | 1·52 | 1·72 | 1·85 | 4·89 | 2·03 | 2·99 | 2·75 | 2·47 | 27·92 |
| 1882 | 1·30 | 1·30 | 1·35 | 2·83 | 1·20 | 2·30 | 2·95 | 1·48 | 2·39 | 4·96 | 2·57 | 2·51 | 27·14 |
| 1883 | 2·08 | 3·62 | ·86 | 1·56 | 1·97 | 1·35 | 2·92 | ·93 | 3·83 | 1·75 | 2·78 | ·75 | 24·40 |
| 1884 | 2·30 | 1·40 | 1·41 | 1·02 | ·78 | 2·84 | 2·46 | ·89 | 1·77 | ·99 | 1·92 | 2·57 | 20·35 |
| 1885 | 1·43 | 2·86 | 1·65 | 2·32 | 2·63 | 1·99 | ·52 | ·85 | 4·30 | 3·73 | 3·31 | 1·05 | 26·64 |

TABLE XI.—*continued.*

| Year. | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|-------|------|------|------|-------|------|------|------|------|-------|------|------|------|--------|
| | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. |
| 1886 | 4·02 | ·63 | 1·38 | 1·22 | 4·79 | ·63 | 2·37 | ·76 | 1·73 | 2·43 | 2·71 | 4·34 | 27·01 |
| 1887 | 1·26 | ·48 | 1·65 | 1·41 | 1·45 | ·91 | 1·07 | 3·15 | 1·81 | 1·24 | 3·40 | 1·38 | 19·21 |
| 1888 | ·90 | ·78 | 3·34 | 2·37 | 1·18 | 2·31 | 4·91 | 3·61 | 1·43 | 1·23 | 4·38 | 1·29 | 27·73 |
| 1889 | ·81 | 2·28 | 1·36 | 2·06 | 3·22 | 2·03 | 2·64 | 1·80 | 1·77 | 3·75 | ·89 | 1·23 | 23·84 |
| 1890 | 2·46 | 1·04 | 1·76 | 2·02 | 1·25 | 2·82 | 4·19 | 1·55 | ·64 | 1·20 | 1·62 | ·68 | 21·23 |
| 1891 | 1·80 | ·01 | 2·01 | 1·13 | 2·72 | ·86 | 3·82 | 4·75 | 1·03 | 4·80 | 1·98 | 3·24 | 28·15 |
| 1892 | ·50 | 1·62 | 1·04 | ·99 | 1·51 | 2·46 | 1·62 | 3·06 | 2·12 | 3·78 | 2·53 | 1·37 | 22·60 |
| 1893 | 1·44 | 2·87 | ·32 | ·24 | ·80 | ·73 | 2·46 | 1·61 | 1·07 | 3·87 | 2·16 | 2·23 | 19·80 |
| 1894 | 2·87 | 1·74 | 1·18 | 1·74 | 1·85 | 1·84 | 3·25 | 2·85 | 1·04 | 4·45 | 2·85 | 2·28 | 27·94 |
| 1895 | 1·96 | ·12 | 1·42 | 1·34 | ·34 | ·30 | 3·42 | 3·09 | 1·28 | 2·84 | 3·17 | 2·19 | 21·47 |
| 1896 | ·78 | ·29 | 3·20 | ·55 | ·14 | 2·27 | 1·03 | 1·92 | 5·51 | 3·05 | 1·17 | 3·61 | 23·52 |
| 1897 | 2·05 | 2·75 | 3·42 | 1·57 | 1·08 | 1·87 | ·64 | 2·92 | 2·75 | ·56 | 1·05 | 2·20 | 22·86 |
| 1898 | ·73 | 1·08 | 1·46 | 1·01 | 2·26 | 1·11 | 1·09 | 1·18 | ·33 | 2·96 | 1·94 | 2·54 | 17·69* |
| 1899 | 2·52 | 2·00 | ·50 | 2·64 | 1·38 | 1·49 | 1·45 | ·70 | 2·65 | 2·03 | 4·13 | 1·05 | 22·54 |
| Mean | 2·00 | 1·58 | 1·68 | 1·67 | 1·91 | 2·19 | 2·33 | 2·31 | 2·35 | 2·70 | 2·33 | 2·12 | 25·20 |

Greatest fall in one civil year (1878), 34·08.

" " twelve months (March 1878 to February 1879), 37·92

" " six months (March to August 1878), 24·06.

" " three months (March, April, May 1878), 15·57.

" " two months (December 1876, January 1877), 10·99

" " one month (August 1878), 6·72.

Least fall in one civil year (1864), 16·93.

" " twelve months (October 1897 to September 1898), 14·06.

" " six months (December 1873 to June 1874), 5·36.

" " four months (December 1873 to March 1874), 2·96.

" " three months (February, March, April, 1863), 1·94.

" " two months (March, April, 1893), ·56.

" " one month (February 1891), ·01.

Least average of three consecutive years (1897-8-9), 21·03.

* This was the total fall registered at Camden Square, but much lower records were obtained at other stations at lower elevation, viz. at Shoreditch, 14·30; East Ham, 14·08; Barking Outfall, 13·04—thus making 1898 the driest year for half a century over a considerable area.

TABLE XI.—*continued.*(2) Average Monthly Rainfall at various stations in British Isles during
30 Years, 1870-1899.

| Station. | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
|-----------------------------------|------|------|-------|-------|-----|------|------|------|-------|------|------|------|--------|
| | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. |
| ENGLAND. | | | | | | | | | | | | | |
| Camden Square . . . | 1.9 | 1.6 | 1.6 | 1.7 | 1.7 | 2.1 | 2.5 | 2.4 | 2.3 | 2.8 | 2.4 | 2.1 | 25.0 |
| Eastbourne . . . | 2.7 | 2.1 | 2.0 | 1.9 | 1.6 | 1.8 | 2.4 | 2.4 | 3.1 | 4.1 | 3.7 | 3.2 | 31.0 |
| Hitchin . . . | 1.8 | 1.5 | 1.5 | 1.6 | 1.9 | 1.9 | 2.5 | 2.3 | 2.3 | 2.7 | 2.6 | 2.0 | 24.7 |
| High Wycombe . . . | 2.2 | 1.8 | 1.6 | 1.6 | 1.6 | 1.8 | 2.1 | 2.1 | 2.4 | 2.9 | 2.6 | 2.3 | 24.9 |
| Ely . . . | 1.3 | 1.1 | 1.1 | 1.4 | 1.8 | 2.0 | 2.8 | 2.4 | 2.2 | 2.4 | 2.1 | 1.5 | 22.2 |
| Marlborough . . . | 2.6 | 2.2 | 1.9 | 2.0 | 1.9 | 2.2 | 2.8 | 2.7 | 2.6 | 3.3 | 3.3 | 2.7 | 30.2 |
| Barnstaple . . . | 3.4 | 2.8 | 2.3 | 2.2 | 2.1 | 2.3 | 3.3 | 3.4 | 3.6 | 4.9 | 4.0 | 4.1 | 38.5 |
| Ross (Hereford) . . . | 2.7 | 2.2 | 1.7 | 1.9 | 2.1 | 2.3 | 2.8 | 2.6 | 2.7 | 3.1 | 2.9 | 2.4 | 29.4 |
| Ormskirk . . . | 2.7 | 2.0 | 2.2 | 1.7 | 2.1 | 2.4 | 3.4 | 3.6 | 3.4 | 3.9 | 3.2 | 3.1 | 33.7 |
| Cartmel (Lancs.) . . | 3.9 | 2.9 | 3.1 | 2.2 | 2.4 | 2.8 | 3.9 | 4.4 | 4.4 | 5.0 | 4.3 | 4.2 | 43.7 |
| Old Malton (Yorks) . | 1.9 | 1.7 | 1.8 | 1.7 | 1.9 | 2.1 | 2.6 | 2.7 | 2.3 | 3.1 | 2.5 | 2.4 | 26.7 |
| Kendal . . . | 5.2 | 3.7 | 3.8 | 2.4 | 2.9 | 3.0 | 4.3 | 4.9 | 4.6 | 5.3 | 4.9 | 5.3 | 50.4 |
| WALES. | | | | | | | | | | | | | |
| Haverfordwest . . . | 5.1 | 3.7 | 3.0 | 2.6 | 2.5 | 2.6 | 3.7 | 4.0 | 4.2 | 5.6 | 5.4 | 5.2 | 48.0 |
| Llandudno . . . | 2.6 | 2.0 | 2.0 | 1.8 | 1.8 | 2.0 | 2.6 | 2.9 | 2.9 | 4.1 | 3.4 | 2.9 | 31.1 |
| SCOTLAND. | | | | | | | | | | | | | |
| Bothwell Castle (Lanark) . . . | 2.6 | 1.9 | 1.9 | 1.4 | 1.9 | 2.2 | 2.9 | 3.2 | 2.7 | 2.6 | 2.8 | 2.8 | 28.9 |
| Waulk Glen (Ren- frew) . . . | 5.2 | 3.7 | 3.5 | 2.3 | 2.7 | 2.9 | 3.4 | 4.3 | 4.3 | 4.6 | 5.0 | 5.2 | 46.9 |
| Loch Leven . . . | 3.3 | 2.8 | 2.6 | 2.0 | 2.3 | 2.4 | 3.1 | 3.7 | 2.9 | 3.6 | 3.7 | 3.7 | 36.2 |
| Craigton . . . | 3.0 | 2.9 | 2.6 | 2.6 | 2.5 | 2.7 | 3.6 | 4.1 | 3.2 | 3.5 | 3.5 | 3.5 | 37.7 |
| Braemar . . . | 2.9 | 2.7 | 2.4 | 2.2 | 2.4 | 2.4 | 2.9 | 3.8 | 3.2 | 4.1 | 3.9 | 3.1 | 36.0 |
| IRELAND. | | | | | | | | | | | | | |
| Portlaw (Water- ford) . . . | 4.5 | 3.7 | 2.7 | 2.9 | 2.5 | 2.6 | 3.2 | 3.9 | 3.2 | 4.3 | 4.1 | 4.7 | 42.2 |
| Bray . . . | 3.8 | 3.6 | 2.9 | 2.8 | 2.6 | 2.5 | 2.9 | 3.3 | 3.0 | 4.7 | 4.4 | 3.9 | 40.5 |
| Ballinasloe . . . | 3.5 | 2.5 | 2.4 | 2.4 | 2.5 | 2.7 | 3.4 | 3.9 | 3.2 | 3.6 | 3.6 | 3.6 | 37.0 |
| Armagh . . . | 2.6 | 2.1 | 2.0 | 2.0 | 2.1 | 2.5 | 3.2 | 3.3 | 2.9 | 3.0 | 2.8 | 2.8 | 31.3 |
| Omagh (Tyrone) . . | 3.4 | 2.5 | 2.5 | 2.2 | 2.4 | 2.9 | 3.3 | 4.0 | 3.6 | 3.7 | 3.5 | 3.8 | 37.8 |
| Average of 24 Stations . . . | 3.1 | 2.5 | 2.3 | 2.1 | 2.2 | 2.4 | 3.1 | 3.3 | 3.1 | 3.7 | 3.5 | 3.4 | 34.8 |

TABLE XII.—DAILY and HOURLY MAXIMUM RAINFALL.

| Period. | Greatest Ordinary Heavy Fall (as defined in "British Rainfall," all beyond this being recorded as "Exceptional"). | Exceptional Falls recorded during the Years 1870 to 1899. |
|---------|---|---|
| hours | | Fall during the Year. |
| | 2½ inches, where the total fall during the year exceeds 33 inches. | 8·03 at Seathwaite, Cumberland, in 1897 143·4 7·74 at Ben Nevis Observatory in 1894 151·7 6·70 at Angerton, near Morpeth, in 1898 36·9 (During an extraordinary storm which lasted only about 3 hours.) 6·00 at Tongue, Sutherland, in 1870 .. 35·1 5·00 at Blaenau Festiniog, in 1898 . . 126·9 |
| 24 | 7·5 per cent. of the fall during the year, where it does not exceed 33 inches. | 4·78 at Sittingbourne, being 17·7 p. c. of 27·0. 4·48 at Fakenham, being 16·2 p. c. of 27·6. 4·45 at N. Ockendon, Essex, being 16·5 p. c. of 27·0. 4·83 at Churchstoke, Montgomery, being 16·1 p. c. of 30. 4·93 at Galway, being 13 p. c. of 37·9. |
| 2 | { 1 inch, or at rate of 1·50 in. per hr. } | { 3·75 inches. Flax Bourton, Somerset, July 16, 1892. 3 inches. Rotherham, September 15, 1880. |
| 1½ | { 1·85 inch, or at rate of 1·56 in. per hr. } | { 3·07 inches = 2·05 in. per hour. Athlone, June 25, 1880. |
| 1 | 1·75 inch . . . | 2·58 inches. Sale, July 25, 1886. |
| min. 45 | { 1·65 inch, or at rate of 1·87 in. per hr. } | |
| 30 | { 1·50 inch, or at rate of 1 in. per hr. } | { 2·90 inches = 5·80 in. per hour. Cowbridge, South Wales, July 22, 1880. |
| 20 | { 1·40 inch, or at rate of 1·20 in. per hr. } | { 1·48 inches = 4·44 in. per hour. Barnstaple, June 30, 1879. |
| 15 | { 1·35 inch, or at rate of 1·40 in. per hr. } | { 0·75 inch = 3 in. per hour. Oxford, August 6, 1898. |
| 10 | { 1·30 inch, or at rate of 1·80 in. per hr. } | { 1 inch = 6 in. per hour. London, June 23, 1878. |
| 5 | { 1·20 inch, or at rate of 2·40 in. per hr. } | { 1·40 inch in 3 minutes = 8 in. per hour. London, June 23, 1878. |

TABLE XIII.—WATER SUPPLY by GRAVITATION—

NOTE.—Dimensions of Service Reservoirs and Distributing

| Population. | Supply Required at 20 Gallons per Head. | | Area of Gathering Ground for 12 Inches Available Rainfall. | Storage Reservoir to Hold Supply for 150 Days. | | |
|-------------|---|------------------------|--|--|--------|--|
| | Daily. | Equivalent per Minute. | | | | |
| | gallons | gallons | acres | | | |
| 500 | 10,000 | 7 | 13½ | 175 ft. diam. by 10 ft. deep | | |
| 1,000 | 20,000 | 14 | 27 | 226 | " 12 " | |
| 2,000 | 40,000 | 28 | 53½ | 320 | " 12 " | |
| 3,000 | 60,000 | 42 | 80½ | { 391 " 12 " } 2½ acres by 12 " } | | |
| 5,000 | 100,000 | 70 | 134 | 3½ | " 15 " | |
| 6,000 | 120,000 | 84 | 161 | 4½ | " 15 " | |
| 8,000 | 160,000 | 112 | 215 | 6 | " 15 " | |
| 10,000 | 200,000 | 139 | 268 | { 7½ " 15 " } 5½ " 20 " } | | |
| 20,000 | 400,000 | 278 | 536 | { 15 " 15 " } 11 " 20 " } | | |
| 30,000 | 600,000 | 417 | 805 | 16½ | " 20 " | |
| 50,000 | 1,000,000 | 694 | 1340 | 27½ | " 20 " | |
| 60,000 | 1,200,000 | 833 | 1610 | 33 | " 20 " | |
| 80,000 | 1,600,000 | 1,111 | 2145 | 44 | " 20 " | |
| 100,000 | 2,000,000 | 1,389 | sq. miles 4.2 | { 55 " 20 " } 44 " 25 " } | | |
| | | | | { 220 " 25 " } 183 " 30 " } | | |
| 500,000 | 10,000,000 | 6,944 | 21 | { 440 " 25 " } 367 " 30 " } | | |
| 1,000,000 | 20,000,000 | 13,889 | 42 | { 440 " 25 " } 367 " 30 " } | | |

WORKS for GIVEN POPULATION.

Mains same as for Pumping Works. (See next page.)

| Filter Beds to Pass 600 Gallons per Super. Yard in 24 Hours, allowing for one not in use. | | Main Conduit to Pass Supply in 24 Hours, flowing continuously. | |
|---|------------------|---|----------|
| No. 2, each | 15 ft. by 10 ft. | { 1½ inch, loss of head | 1 in 120 |
| " " | " " | { 2 " " " | 1 " 400 |
| " " | 20 " 15 " | { 2 " " " | 1 " 120 |
| " " | " " | { 3 " " " | 1 " 1000 |
| No. 3, " | 30 " 10 " | { 3 " " " | 1 " 240 |
| " " | " " | { 4 " " " | 1 " 1000 |
| " " | 30 " 15 " | { 4 " " " | 1 " 450 |
| " " | " " | { 5 " " " | 1 " 1200 |
| " " | 50 " 15 " | { 4 " " " | 1 " 160 |
| " " | " " | { 6 " " " | 1 " 1200 |
| " " | 50 " 18 " | { 5 " " " | 1 " 350 |
| " " | " " | { 6 " " " | 1 " 900 |
| " " | 60 " 20 " | { 6 " " " | 1 " 500 |
| " " | " " | { 7 " " " | 1 " 1000 |
| No. 4, " | 50 " 20 " | { 6 " " " | 1 " 300 |
| " " | or 32 ft. sq. | { 8 " " " | 1 " 1250 |
| No. 4, each | 45 ft. square .. | { 9 " " " | 1 " 600 |
| " " | " " | { 10 " " " | 1 " 1000 |
| " " | 55 " " | { 10 " " " | 1 " 450 |
| " " | " " | { 12 " " " | 1 " 1000 |
| " " | 70 " " | { 12 " " " | 1 " 400 |
| " " | " " | { 15 " " " | 1 " 1200 |
| " " | 76 " " | { 12 " " " | 1 " 275 |
| " " | " " | { 15 " " " | 1 " 850 |
| " " | 90 " " | { 15 " " " | 1 " 480 |
| " " | " " | { 18 " " " | 1 " 1200 |
| No. 6, " | 77½ " " | { 18 " " " | 1 " 750 |
| " " | " " | { 21 " " " | 1 " 1700 |
| " " | 173 " " | { 2½ feet, " " | 1 " 400 |
| " " | " " | { 3 " " " | 1 " 1000 |
| " " | 245 " " | { 3 " " " | 1 " 250 |
| " " | " " | { 4 " " " | 1 " 1000 |

TABLE XIV.—WATER SUPPLY by PUMPING—

| Population. | Supply Required at 20 Gallons per Head. | | Hours during which it is proposed to Pump. | Net Horse-power to raise to 100 Feet Elevation. |
|-------------|---|------------------------|--|---|
| | Daily. | Equivalent per Minute. | | |
| 500 | gallons 10,000 | gallons 7 | 4 | 1½ |
| 1,000 | 20,000 | 14 | 6 | 1½ |
| 2,000 | 40,000 | 28 | 10 | 2 |
| 3,000 | 60,000 | 42 | 10 | 3 |
| 5,000 | 100,000 | 70 | 10 | 5 |
| 6,000 | 120,000 | 84 | 10 | 6 |
| 8,000 | 160,000 | 112 | 10 | 8 |
| 10,000 | 200,000 | 139 | 10 | 10½ |
| 20,000 | 400,000 | 278 | 18 | 11½ |
| 30,000 | 600,000 | 417 | 24 | 12½ |
| 50,000 | 1,000,000 | 694 | 24 | 21 |
| 60,000 | 1,200,000 | 833 | 24 | 25½ |
| 80,000 | 1,600,000 | 1,111 | 24 | 33½ |
| 100,000 | 2,000,000 | 1,389 | 24 | 42 |
| 500,000 | 10,000,000 | 6,944 | 24 | 210 |
| 1,000,000 | 20,000,000 | 13,889 | 24 | 421 |

WORKS for GIVEN POPULATION.

| Dimensions of Single Pump, working 10 Strokes per Minute. | | | Dimensions of Pumping Main. | | Service Reservoir to hold Three Days' Supply. | Main Delivery Pipe to Pass at Rate of One-half in Four Hours. | |
|---|---------|-----|-----------------------------|---------------|---|---|---------------|
| Diam. | Stroke. | | Diam. | Loss of Head. | | Diam. | Loss of Head. |
| in. | ft. | in. | in. | | | in. | |
| 8 | 2 | 0 | 3 | 1 in 110 | 22 ft. sq. by 10 ft. deep | 3 | 1 in 400 |
| 9 | 2 | 0 | 4 | 1 „ 450 | 31 „ 10 „ | 4 | 1 „ 450 |
| 10 | 2 | 0 | 5 | 1 „ 500 | 40 „ 12 „ | 5 | 1 „ 350 |
| 12 | 2 | 1 | 5 | 1 „ 240 | 49 „ 12 „ | 6 | 1 „ 380 |
| 14 | 2 | 6 | 6 | 1 „ 220 | 56½ „ 15 „ | 8 | 1 „ 580 |
| 15 | 2 | 8 | 7 | 1 „ 330 | 62 „ 15 „ | 8 | 1 „ 400 |
| 16 | 3 | 0 | 8 | 1 „ 350 | 71½ „ 15 „ | 9 | 1 „ 400 |
| 18 | 3 | 1 | 9 | 1 „ 400 | 80 „ 15 „ | 10 | 1 „ 450 |
| 18 | 3 | 4½ | 9 | 1 „ 335 | 98 „ 20 „ | 15 | 1 „ 850 |
| 18 | 3 | 9 | 10 | 1 „ 450 | 120 „ 20 „ | 15 | 1 „ 440 |
| 21 | 5 | 0 | 12 | 1 „ 400 | 155 „ 20 „ | 18 | 1 „ 310 |
| 24 | 4 | 3 | 15 | 1 „ 850 | 170 „ 20 „ | 21 | 1 „ 500 |
| 24 | 5 | 8 | 15 | 1 „ 475 | 196 „ 20 „ | 24 | 1 „ 570 |
| 24 | 7 | 0 | 18 | 1 „ 770 | 220 „ 20 „ | 27 | 1 „ 650 |
| 3·9 | 10 | 0 | ft. in. 2 6 | 1 „ 385 | 438 „ 25 „ | ft. in. 4 0 | 1 „ 500 |
| 5·0 | 11 | 4 | 3 0 | 1 „ 245 | 620 „ 25½ „ | 6 0 | 1 „ 880 |

| | | | | | | | | | | | | |
|--|----|----|----|----|--------------|--------------|--------|---------------|--------------|----------------|---------------|--|
| Oolites—Spalding Peterborough | .. | .. | .. | .. | 68.4 40.5 | 10.0 28.2 | 0 0 | 14.85 1.95 | .056 .. | -.074 0 | .004 .002 | { Average of many brackish wells. (The solids contain sulphates of lime and magnesia.) |
| Keuper or Marl Beds, Burton-on-Trent .. | .. | .. | .. | .. | 220.0 | .. | .. | .08 6.5 | .. | -.003 .004 | .004 | |
| Carboniferous Limestone, Ingleton, Yorks | .. | .. | .. | .. | 13.5 | 10.0 | 4.0 | .. | .. | -.005 .005 | .005 | |
| <i>Waters from shallow wells.</i> | | | | | | | | | | | | |
| Burnham, Essex (public supply) | .. | .. | .. | .. | 49.3 | 21.4 | 11.4 | 1.20 | 5.0 | -.0005 .003 | .005 .007 | { Well 15 feet deep, in river gravel. (Average of a great many wells, various depths, in gravel overlying Keuper beds. (Average of 40 wells in gravel, liable to pollution.) |
| St. Neots, Hunts (public supply) | .. | .. | .. | .. | 51.4 | 31.4 | 14.3 | .98 | 3.4 | -.003 .006 | .007 | |
| Burton-on-Trent (private wells) | .. | .. | .. | .. | 111.0 | .. | .. | 1.6 8.5 | .. | -.006 .017 | .008 .020 | |
| Southminster, Essex (private wells) | .. | .. | .. | .. | 123.0 | 33.0 | .. | 2.4 1.6 | .25 | -.017 .003 | .020 | |
| <i>Waters supplied from upland surfaces.</i> | | | | | | | | | | | | |
| Glaesgow, Loch Katrine | .. | .. | .. | .. | 2.76 | 1.4 | .. | .006 .57 | .. | 0 .005 | .003 .003 | { Moorland, Lower Silurian rocks. Moorland, Millstone Grit. Moorland. Moorland, Silurian rocks. Cultivated land, subsoil, North- ampton sand. Principally moorland, subsoil granite. |
| Manchester, Longdendale | .. | .. | .. | .. | 17.0 | 10.0 | 10.0 | .07 1.4 | .. | -.005 .003 | .003 | |
| Liverpool, Rivington Pike | .. | .. | .. | .. | 9.2 | 5.6 | .. | 0 1.5 | .045 .132 | -.003 .002 | .. | |
| Liverpool, Lake Vyrnwy | .. | .. | .. | .. | 4.16 | 2.4 | .. | 0 .9 | .132 .100 | -.002 0 | .. | |
| Kettering | .. | .. | .. | .. | 20.4 | 15.0 | 7.0 | .043 1.51 | .100 | 0 .0007 | .0114 .002 | { Average of analyses taken weekly throughout year 1892. (Average daily, every 3 hours, throughout year 1894. " " " " " " |
| Plymouth | .. | .. | .. | .. | 2.8 | 2.1 | 2.1 | .014 1.14 | .124 | -.0007 .007 | .002 | |
| <i>Other waters, &c.</i> | | | | | | | | | | | | |
| River Thames at Hampton | .. | .. | .. | .. | 34.0 | 19.0 | 6.5 | .199 1.75 | .186 | -.007 .007 | .017 | |
| London Sewage—Northern outfall | .. | .. | .. | .. | 86.0 | .. | .. | .. 15.7 | 4.46 4.32 | -.504 .600 | .504 | |
| Southern outfall | .. | .. | .. | .. | 129.7 | .. | .. | .. 35.4 | 5.27 4.23 | -.07 .07 | .600 | |
| Crofton Sewage—Effluent from Farm | .. | .. | .. | .. | 46.0 | .. | .. | .88 3.25 | 1.13 4.55 | -.07 .493 | .07 | |
| Crofton Sewage—Crude Effluent from Bacteria Beds | .. | .. | .. | .. | 157.9 | .. | .. | 0 11.47 | 2.94 3.00 | -.493 .147 | .493 | |
| Water | .. | .. | .. | .. | 97.8 | .. | .. | 3.43 8.53 | 0.83 0.34 | -.147 .027 | .147 | { The analyses of sewage are ex- clusive of suspended matters. |
| Water | .. | .. | .. | .. | 3800 | 800 | 750 | .03 2000 | .. | -.005 .005 | .027 | |

TABLE XVI.—QUANTITY OF BRICKWORK IN CIRCULAR SEWERS, CULVERTS, OR WELLS.

NOTE.—The quantity of earth displaced will be the sum of the contents and brickwork added together.

| Internal Diameter. | Contents of One Lineal Yard. | Brickwork per Lineal Yard. | | Internal Diameter. | Contents of One Lineal Yard. | Brickwork per Lineal Yard. | |
|--------------------|------------------------------|----------------------------|-----------------|--------------------|------------------------------|----------------------------|------------------|
| | | 4½ Inches Thick. | 9 Inches Thick. | | | 9 Inches Thick. | 14 Inches Thick. |
| ft. in. | cub. ft. | cub. ft. | cub. ft. | ft. in. | cub. ft. | cub. ft. | cub. ft. |
| 1 6 | 5.3 | 6.6 | 15.9 | 6 0 | 84.8 | 47.7 | 75.6 |
| 1 9 | 7.2 | 7.5 | 17.7 | 6 6 | 99.5 | 51.2 | 80.8 |
| 2 0 | 9.4 | 8.4 | 19.4 | 7 0 | 115.5 | 54.8 | 86.1 |
| 2 3 | 11.9 | 9.3 | 21.2 | 7 6 | 132.5 | 58.3 | 91.5 |
| 2 6 | 14.7 | 10.1 | 23.0 | 8 0 | 150.8 | 61.8 | 96.8 |
| 2 9 | 17.8 | 11.0 | 24.7 | 8 6 | 170.2 | 65.4 | 102.1 |
| 3 0 | 21.2 | 11.9 | 26.5 | 9 0 | 190.9 | 68.9 | 107.4 |
| 3 3 | 24.9 | 12.7 | 28.3 | 9 6 | 212.6 | 72.4 | 112.7 |
| 3 6 | 28.9 | 13.7 | 30.0 | 10 0 | 235.6 | 76.0 | 118.0 |
| 3 9 | 33.1 | 14.6 | 31.8 | 11 0 | 285.1 | 83.1 | 128.5 |
| 4 0 | 37.6 | 15.5 | 33.6 | 12 0 | 339.3 | 90.0 | 139.1 |
| 4 6 | 47.7 | 17.2 | 37.1 | 13 0 | 398.2 | 97.2 | 149.8 |
| 5 0 | 58.9 | 19.0 | 40.6 | 14 0 | 461.8 | 104.2 | 160.35 |
| 5 6 | 71.3 | 20.7 | 44.2 | 15 0 | 530.1 | 111.3 | 171.0 |

TABLE XVII.—QUANTITY OF BRICKWORK IN EGG-SHAPED SEWERS.

| Internal Dimensions. | Contents of One Lineal Yard. | Brickwork per Lineal Yard. | | Internal Dimensions. | Contents of One Lineal Yard. | Brickwork per Lineal Yard. | |
|----------------------|------------------------------|----------------------------|--------------|----------------------|------------------------------|----------------------------|--------------|
| | | 4½ In. Thick. | 9 In. Thick. | | | 4½ In. Thick. | 9 In. Thick. |
| ft. in. ft. in. | cub. ft. | cub. ft. | cub. ft. | ft. in. ft. in. | cub. ft. | cub. ft. | cub. ft. |
| 2 0×1 4 | 6.0 | 7.4 | 16.5 | 3 6×2 4 | 18.5 | 11.6 | 25.5 |
| 2 3×1 6 | 8.2 | 8.1 | 18.8 | 3 9×2 6 | 21.2 | 12.4 | 26.9 |
| 2 6×1 8 | 9.4 | 8.8 | 20.1 | 4 0×2 8 | 24.2 | 13.0 | 28.3 |
| 2 9×1 10 | 11.4 | 9.5 | 21.4 | 4 6×3 0 | 32.9 | 14.4 | 31.1 |
| 3 0×2 0 | 13.6 | 10.2 | 22.7 | 5 0×3 4 | 37.7 | 15.8 | 34.0 |
| 3 3×2 2 | 15.9 | 10.9 | 24.0 | 6 0×4 0 | 54.2 | 18.8 | 39.4 |

In egg-shaped sewers about one-seventh part of the brickwork forms the invert, three-sevenths the top, and three-sevenths the sides. The two former should generally be built with radiating bricks of the radius required in each case.

TABLE XVIII.—WEIGHT OF CAST-IRON PIPES.

NOTE.—The weight includes proportion due to sockets, pipes of 2 and 2½ inches diameter being in 6-feet lengths, pipes 3 to 12 inches inclusive in 9-feet lengths, and those of larger size in 12-feet lengths, exclusive of socket.

| Internal Diameter of Pipe. | For Pressure not exceeding 150 Feet. | | | For Pressure not exceeding 300 Feet. | | | For Pressure not exceeding 500 Feet. | | |
|----------------------------------|---|---------------------|-----------|---|---------------------|-----------|---|---------------------|-----------|
| | Thick- ness of Metal. | Weight per Yard. | | Thick- ness of Metal. | Weight per Yard. | | Thick- ness of Metal. | Weight per Yard. | |
| inches | inch | cwt. | qrs. lbs. | inch | cwt. | qrs. lbs. | inch | cwt. | qrs. lbs. |
| 2 | $\frac{9}{32}$ | 0 | 0 24 | $\frac{9}{16}$ | 0 | 0 26 | $\frac{11}{32}$ | 0 | 1 0 |
| 2½ | $\frac{5}{16}$ | 0 | 1 0 | $\frac{11}{32}$ | 0 | 1 2 | $\frac{3}{8}$ | 0 | 1 6 |
| 3 | $\frac{5}{16}$ | 0 | 1 5 | $\frac{11}{32}$ | 0 | 1 9 | $\frac{3}{8}$ | 0 | 1 14 |
| 4 | $\frac{11}{32}$ | 0 | 1 22 | $\frac{3}{8}$ | 0 | 1 26 | $\frac{7}{16}$ | 0 | 2 5 |
| 5 | $\frac{3}{8}$ | 0 | 2 14 | $\frac{7}{16}$ | 0 | 2 21 | $\frac{1}{2}$ | 0 | 3 4 |
| 6 | $\frac{3}{8}$ | 0 | 2 21 | $\frac{7}{16}$ | 0 | 3 5 | $\frac{1}{2}$ | 0 | 3 21 |
| 7 | $\frac{7}{16}$ | 0 | 3 24 | $\frac{1}{2}$ | 1 | 0 12 | $\frac{9}{16}$ | 1 | 1 0 |
| 8 | $\frac{7}{16}$ | 1 | 0 12 | $\frac{1}{2}$ | 1 | 1 0 | $\frac{9}{16}$ | 1 | 1 21 |
| 9 | $\frac{1}{2}$ | 1 | 1 12 | $\frac{9}{16}$ | 1 | 2 2 | $\frac{5}{8}$ | 1 | 2 21 |
| 10 | $\frac{1}{2}$ | 1 | 2 0 | $\frac{9}{16}$ | 1 | 2 21 | $\frac{5}{8}$ | 1 | 3 14 |
| 12 | $\frac{9}{16}$ | 2 | 0 0 | $\frac{5}{8}$ | 2 | 0 25 | $\frac{11}{16}$ | 2 | 1 21 |
| 14 | $\frac{5}{8}$ | 2 | 2 18 | $\frac{11}{16}$ | 2 | 3 21 | $\frac{3}{4}$ | 3 | 0 21 |
| 15 | $\frac{5}{8}$ | 2 | 3 7 | $\frac{11}{16}$ | 3 | 0 10 | $\frac{13}{16}$ | 3 | 2 14 |
| 16 | $\frac{5}{8}$ | 3 | 0 0 | $\frac{3}{4}$ | 3 | 2 9 | $\frac{7}{8}$ | 4 | 0 21 |
| 18 | $\frac{11}{16}$ | 3 | 2 0 | $\frac{3}{4}$ | 4 | 0 0 | $\frac{15}{16}$ | 4 | 3 21 |
| 21 | $\frac{11}{16}$ | 4 | 1 0 | $\frac{13}{16}$ | 5 | 0 0 | 1 | 6 | 1 14 |
| 24 | $\frac{3}{4}$ | 5 | 1 0 | $\frac{7}{8}$ | 6 | 1 0 | $1\frac{1}{8}$ | 8 | 0 0 |
| 27 | $\frac{3}{4}$ | 6 | 0 0 | $\frac{15}{16}$ | 7 | 2 0 | $1\frac{3}{8}$ | 9 | 1 0 |
| 30 | $\frac{7}{8}$ | 7 | 3 14 | 1 | 8 | 3 21 | $1\frac{1}{2}$ | 11 | 1 0 |
| 36 | 1 | 10 | 2 21 | $1\frac{1}{8}$ | 11 | 2 14 | $1\frac{1}{2}$ | 15 | 3 14 |

TABLE XIX.—WEIGHT OF LEAD PIPES.

NOTE.—Columns 1, 2, and 3 are the pipes usually known as “common,” “middling,” and “strong,” respectively, the figures in parenthesis show the weights per length of the coil according to which they are generally specified. The “common” are available only for pipes with open ends, the “middling” for very slight pressures, and the “strong” for pressure of about 50 feet.

Column 4 are the weights prescribed by the Metropolis Water Act, 1871, and by the regulations of very many towns, and are available for pressures up to 200 feet or thereabouts.

Column 5 are those prescribed at Norwich and some other towns where the pressure is unusually great.

| Internal Diameter of Pipe. | Weight per Yard in Lbs. | | | | |
|----------------------------|-------------------------------------|-------------------------------------|--------------------------------------|-----------------|------------------|
| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. |
| $\frac{3}{8}$ inch | .. | .. | .. | 5 | 5 $\frac{1}{2}$ |
| $\frac{1}{2}$ " | 3 $\frac{1}{2}$ (16 lbs. to 15 ft.) | 4 $\frac{3}{8}$ (22 lbs. to 15 ft.) | 5 $\frac{1}{2}$ (26 lbs. to 15 ft.) | 6 | 7 |
| $\frac{5}{8}$ " | .. | .. | .. | 7 $\frac{1}{2}$ | 9 |
| $\frac{3}{4}$ " | 4 $\frac{3}{8}$ (24 lbs. to 15 ft.) | 5 $\frac{3}{8}$ (28 lbs. to 15 ft.) | 7 $\frac{1}{2}$ (36 lbs. to 15 ft.) | 9 | 11 |
| 1 " | 6 (30 lbs. to 15 ft.) | 8 (40 lbs. to 15 ft.) | 9 $\frac{3}{8}$ (46 lbs. to 15 ft.) | 12 | 16 |
| 1 $\frac{1}{4}$ " | 9 (36 lbs. to 12 ft.) | 11 (44 lbs. to 12 ft.) | 13 (53 lbs. to 12 ft.) | 16 | 22 $\frac{1}{2}$ |
| 1 $\frac{1}{2}$ " | 12 (48 lbs. to 12 ft.) | 14 (56 lbs. to 12 ft.) | 17 $\frac{1}{2}$ (70 lbs. to 12 ft.) | 24 | 33 |

APPENDIX.

VELOCITY AND DISCHARGE PER MINUTE IN CIRCULAR SEWERS, WITH WATER FLOWING AT VARIOUS DEPTHS.
Diameter 6 inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|---------------|---|------------|--------------------------|------------|--|------------|--|
| | One-quarter. (1½ Inch.) | | One-half. (3 Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| feet per mile | | gallons | feet | gallons | feet | gallons | gallons |
| 1 in 12 | 440 | 105 | 577 | 354 | 632 | 720 | very small |
| 1 " 15 | 352 | 94 | 514 | 316 | 562 | 640 | " |
| 1 " 20 | 264 | 82 | 445 | 273 | 490 | 558 | " |
| 1 " 25 | 176 | 67 | 366 | 224 | 400 | 456 | " |
| 1 " 30 | 132 | 58 | 316 | 194 | 346 | 394 | " |
| 1 " 40 | 105.6 | 52 | 280 | 172 | 308 | 350 | " |
| 1 " 50 | 80 | 45 | 246 | 151 | 270 | 308 | " |
| 1 " 60 | 66 | 40 | 224 | 135 | 244 | 270 | 15 |
| 1 " 80 | 53.8 | 36 | 200 | 123 | 220 | 250 | 35 |
| 1 " 100 | 40 | 32 | 174 | 107 | 190 | 216 | 50 |
| 1 " 125 | 32 | 28 | 155 | 95 | 170 | 194 | 90 |
| 1 " 150 | 26.4 | 26 | 141 | 85 | 154 | 170 | 160 |
| 1 " 200 | 20 | 23 | 123 | 76 | 135 | 149 | not obtainable |
| 1 " 250 | 16 | 20 | 110 | 68 | 120 | 137 | " |

VELOCITY and DISCHARGE per MINUTE in CIRCULAR SEWERS, flowing at various depths.
Diameter 7 inches.

| Inclination. | Depth of Flow in Proportion to Height of Sewer. | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|--------------|---|----------------|---------------------------|----------------|--|----------------|--|
| | One-quarter. (1½ Inch.) | | One-half. (3½ Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| | | | | | | | |
| 1 in 15 | feet 426 | gallons 139 | feet 556 | gallons 466 | feet 610 | gallons 945 | gallons very small |
| 1 " 20 | 362 | 120 | 482 | 405 | 539 | 930 | " |
| 1 " 30 | 264 | 98 | 395 | 332 | 433 | 670 | " |
| 1 " 40 | 176 | 85 | 342 | 287 | 374 | 560 | " |
| 1 " 50 | 132 | 76 | 305 | 256 | 336 | 520 | " |
| 1 " 66 | 80 | 66 | 266 | 223 | 292 | 452 | " |
| 1 " 80 | 66 | 60 | 241 | 202 | 264 | 410 | 30 |
| 1 " 100 | 52.8 | 54 | 218 | 183 | 236 | 366 | 40 |
| 1 " 132 | 40 | 47 | 188 | 158 | 205 | 318 | 55 |
| 1 " 165 | 32 | 42 | 168 | 141 | 184 | 285 | 80 |
| 1 " 200 | 26.4 | 38 | 152 | 128 | 167 | 210 | 120 |
| 1 " 264 | 20 | 33 | 133 | 112 | 146 | 226 | not obtainable |
| 1 " 330 | 16 | 29 | 119 | 100 | 130 | 200 | " |
| 1 " 440 | 12 | 26 | 103 | 86 | 113 | 75 | " |

VELOCITY and DISCHARGE per MINUTE in CIRCULAR SEWERS, flowing at various depths.
Diameter 8 inches.

| Inclination. | Depth of Flow In Proportion to Height of Sewer. | | | | | | Quantity required to give Velocity of 150 Feet per Minute. |
|---------------|---|------------|--------------------------|------------|--|------------|--|
| | One-quarter. (2 Inches.) | | One-half. (4 Inches.) | | Seven-eighths. (Maximum Discharge.) | | |
| | Velocity. | Discharge. | Velocity. | Discharge. | Velocity. | Discharge. | |
| | | | | | | | |
| feet per mile | feet | gallons | feet | gallons | feet | gallons | gallons |
| 1 in 15 | 352 | 194 | 598 | 450 | 654 | 1330 | very small |
| 1 " 20 | 264 | 395 | 518 | 390 | 566 | 1160 | " |
| 1 " 30 | 176 | 324 | 424 | 320 | 460 | 940 | " |
| 1 " 40 | 132 | 280 | 366 | 275 | 400 | 820 | " |
| 1 " 50 | 105.6 | 250 | 327 | 245 | 357 | 730 | " |
| 1 " 66 | 80 | 218 | 286 | 215 | 312 | 640 | 30 |
| 1 " 80 | 66 | 197 | 260 | 196 | 282 | 580 | 40 |
| 1 " 100 | 52.8 | 176 | 228 | 172 | 256 | 525 | 50 |
| 1 " 132 | 40 | 154 | 203 | 152 | 220 | 460 | 62 |
| 1 " 165 | 32 | 138 | 180 | 135 | 197 | 405 | 75 |
| 1 " 200 | 26.4 | 125 | 163 | 122 | 178 | 365 | 97 |
| 1 " 264 | 20 | 110 | 142 | 107 | 156 | 330 | 150 |
| 1 " 330 | 16 | 97 | 128 | 96 | 140 | 285 | not obtainable |
| 1 " 440 | 12 | 85 | 110 | 83 | 122 | 250 | " |

